INVESTIGATION OF PARADISE VALLEY WELL FLUORIDE OVERFEED

(HAL Project No.: 085.20.200)

January 2020

HANSEN ALLEN & LUCE inc
ENGINEERS

SANDY CITY PUBLIC UTILITIES

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ABBREVIATIONS AND UNITS

ac	acre [area]
ac-ft	acre-foot (1 ac-ft = 325,851 gal) [volume]
AMI	Advanced Metering Infrastructure
DDW	Utah Division of Drinking Water
DEQ	Utah Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
EPANET	EPA hydraulic network modeling software
EPS	extended period simulation
gpm	gallons per minute [flow rate]
HAL	Hansen, Allen & Luce, Inc.
HDPE	high-density polyethylene
JVWCD	Jordan Valley Water Conservancy District
L	liter [volume]
LCWTP	Little Cottonwood Water Treatment Plant
MCL	maximum contaminant level
Metro	Metropolitan Water District of Salt Lake and Sandy
MGD	million gallons per day [flow rate]
mg/L	milligrams per liter [concentration]
PDA	pressure-driven analysis
ppb	parts per billion [concentration]
ppm	parts per million [concentration]
POMA	Point of the Mountain Aqueduct
POMWTP	Point of the Mountain Water Treatment Plant
PLC	programmable logic controller
PRV	pressure reducing valve
PSV	pressure sustaining valve
PVC	polyvinyl chloride
psi	pounds per square inch [pressure]
SCADA	Supervisory Control and Data Acquisition
SCPU	Sandy City Public Utilities
SLCoHD	Salt Lake County Health Department
UPS	uninterruptible power supply
WCWID	White City Water Improvement District

EXECUTIVE SUMMARY

PURPOSE

A hydrofluorosilicic acid overfeed occurred at Sandy City's Paradise Valley Well facility on February 5–7, 2019. The purpose of this report is to respond to the requirement from Utah Division of Drinking Water (Division of Drinking Water Administrative Order item 17) and Salt Lake County Health Department (3/1/2019 letter) to: (1) give an explanation as to the cause of the fluoride overfeed that occurred February 5 -7, 2019; and (2) describe steps or mechanisms Sandy City Public Utilities has implemented to date and will implement in the future to ensure a fluoride overfeed will not happen again.

CAUSE

The well had not operated since July 2016. Since the well still could have operated at any time if needed, no shutdown procedure occurred for the fluoridation system. The fluoride dosing pump was plugged in, the tubes were primed, the day tank was stocked, and the valves were set. All the physical components were in place. If the programmable logic controller allowed, the fluoride dosing pump would run.

Two main factors contributed to the overfeed:

1. **HAND setting of fluoride dosing pump.** The control for the fluoride dosing pump is normally set to AUTO, which prevents it from running without a water source. The fluoride dosing pump is powered through a special electrical outlet with interlock protection. In AUTO, the outlet is only energized when the well is running. However, during a PLC upgrade on December 19, 2018, the control was set to HAND (a mode used for testing), which bypasses this protection. Being a digital setting on the PLC screen rather than a mechanical switch, the HAND setting was not immediately visible. With the well offline and the fluoride dosing pump not running (for reasons discussed below), operators had no reason to suspect the control was set to HAND.
2. **Faulty shower/eyewash flow switch.** Second, a flow switch tied to the emergency shower and eyewash station prevents the fluoride dosing pump from running when enough water is flowing through the station. (If the eyewash or shower is flowing, it is assumed that there is a chemical problem and that the dosing should cease.) However, the flow switch was stuck in the open (flowing) position, even with no actual flow, and there was no specific visual alarm. Operators had no indication that the flow switch was faulty or that the alarm was active. Even with the control set to HAND, the flow switch and hidden alarm prevented the fluoride dosing pump from running. After January 27, 2019, the flow switch returned to the closed position. A field demonstration proved that a moderate impact, such as tapping on the switch, could spring the switch back to the closed position. On February 5, 2019, an unrelated alarm was cleared in the SCADA system and, since the only option was to "clear all" alarms, the hidden flow switch alarm was also cleared, satisfying the last remaining condition for the fluoride dosing pump to start.

The fluoridation system began injecting 23% hydrofluorosilicic acid, without any well water to dilute it, into Sandy's drinking water system at 6:40 PM on Tuesday, February 5, 2019. It ran until 1:45 PM on Thursday, February 7, 2019, when it was shut down by a Sandy City employee in response to customer complaints.

RESPONSE

In responding to the problem, Sandy City:

1. Began investigating as soon as water quality complaints were received.
2. Sampled water in the affected area.
3. Began flushing the distribution system in the affected area to remove the contaminant (then unknown).
4. Discovered the fluoride dosing pump running and immediately unplugged it.
5. Shut the valve between the fluoride dosing pump and the distribution system.
6. Backflushed the water towards the Paradise Valley Well facility.
7. Reported the incident to the Salt Lake County Health Department (SLCoHD).
8. Conducted door-to-door notifications (after sample results indicated high levels of fluoride) and instructed residents to flush premise plumbing.
9. Used a previously prepared winter scenario hydraulic model to help determine areas where water traveled in the distribution system after the water passed by the well.
10. Reported the incident to the Utah Division of Drinking Water (DDW).
11. Issued a formal public notice with cooperation from DDW and SLCoHD.

These points summarize the City's immediate actions over the first two days. Sampling, flushing, communication, and various other actions continued for several more days and weeks.

RECOMMENDATIONS

The following items are recommended to streamline cooperation among water utilities, regulatory agencies, and emergency response units addressing a water quality incident:

1. **Meeting documentation.** Notes should be kept during phone calls and meetings to document the issues, assignments, and expectations discussed. One person should compile the notes and distribute them by email to the other attendees.
2. **Strategic sampling.** While it is tempting to sample exhaustively during an emergency, it consumes valuable time and resources. Strategic sampling with careful thought toward locations, constituents, and frequency would produce more meaningful information to characterize the situation and inform the response. Obtain emergency sampling kits or portable meters to quickly define the severity and extent of an incident.
3. **Emergency response plans.** The City should keep their emergency response plan up to date and share them with DDW, local health department, and local fire department (who are sometimes the first responders to water quality complaints).
4. **Public notice procedure.** Clarify the procedure for public notices, including who is responsible to draft, approve, distribute, and report completion. Parties should also consider how to proactively use traditional and social media to notify the public throughout the response.

The following items are recommended at all City wells to prevent similar incidents and build response capacity:

1. **Shutdown procedure.** Establish a standard operating procedure (SOP) for shutting down the fluoridation system. At a minimum the SOP should direct operators to unplug the fluoride dosing pump, drain the feed line, shut the valve between the fluoride feed line and discharge pipeline, turn the control switch to OFF, and record these actions in a log. Utilize a lock-out/tag-out procedure for work on the fluoridation system, including PLC/SCADA modifications.
2. **Mechanical switch.** Replace the digital fluoride dosing pump control on the PLC screen with a mechanical switch (HAND/OFF/AUTO) and install a timer for the HAND setting. Remove the HAND setting from the SCADA system to avoid an accidental remote start.
3. **PLC/SCADA procedures.**
    - Audit the current PLC programming for hidden alerts and verify the logic.
    - Remove the command to "clear all" alarms and add the ability to clear only specific alarms.
    - Supervise PLC/SCADA contractors working on site. Update PLC/SCADA work procedures to document changes, functionality, and/or testing and completion logs.
    - Unplug equipment when working on the PLC with appropriate lock-out/tag-out.
    - Develop checklist and in-house capability to review PLC and SCADA programming.
    - At sites with hazardous materials, consider a PLC and/or electrical contact relay alarm and externally visible (red light) and/or audible with signage to call Sandy Emergency Dispatch.
4. **Operation and maintenance.** To avoid using the HAND setting, consider starting the fluoridation system after the well has started and the fluoride dosing pump is set to AUTO. Check the fluoride controls after a power outage or PLC/SCADA work. Fill the day tank with only enough hydrofluorosilicic acid for one day. Do not go more than two days without visiting the site; use asset management system to alert of skipped visits.
5. **Monitoring.** Install an automated pH and fluoride meter downstream of the injection site that can alert operators of an overfeed. Also have handheld pH equipment available for field sampling.
6. **Emergency Response Plan update and training.** Work with DDW and SLCoHD to update public notification forms and Public Water Supplier/Operator training for chemical overfeeds. Review, update, and provide regular training on Sandy Public Utilities Emergency Response Plan, including updated draft public notices for fluoride overfeed and other water quality contamination events (backflow, etc.) and sampling data collection reports. Update Sandy public communications tools and information (social media, reverse 911, door hangers, neighborhood notices, etc.). Update emergency sampling communications, protocols, and resources with primary and backup certified laboratories. Obtain emergency kits or meters to measure fluoride, pH, lead, and copper to be used to quickly define the severity and extent of an incident.

7. **Coordination.** Coordinate with regulatory agencies on further actions and discuss lessons learned.

The City has already implemented many of these recommendations and will complete the rest when this report is approved. The City has now completed mitigation efforts (replacing pipelines and faucets) in homes where lead and copper levels continued to exceed allowable levels. The City also continues to conduct enhanced lead and copper sampling in the affected area as well as distribution system baseline sampling to monitor drinking water quality stabilization. A Corrosion Control Study Plan has been prepared and submitted separately, and the final study plan has been included in Appendix E.

CHAPTER 1 – DRINKING WATER SYSTEM

Sandy City (City) is located in Salt Lake County, Utah. The drinking water system operated by the City serves a population of nearly 100,000. The fluoride overfeed affected the area shown in Figure 1-1.

The City's boundaries and the drinking water service area do not completely align. Because of existing agreements, some areas that have annexed into Sandy are served by White City Water Improvement District (WCWID) or Jordan Valley Water Conservancy District (JVWCD). There are also unincorporated Salt Lake County properties that are served by the City.

The City's drinking water system has been operating for more than 90 years and contains 9 water storage facilities, 8 booster pump stations, 16 wells, 13 total pressure zones, 85 pressure reducing valves (PRVs)/ Pressure Sustaining Valves (PSVs), and approximately 420 miles of distribution pipeline ranging in size from 2 to 36 inches in diameter. The City has 11 total connections to other municipal water suppliers. These connections include 3 wholesale purchase connections, 6 wholesale sale connections, and 2 emergency purchase connections. Since 2017, over 97% (by volume) of the annual water supply is purchased from the Metropolitan Water District of Salt Lake & Sandy (Metro), and the remaining water supply comes from the City's municipal wells.

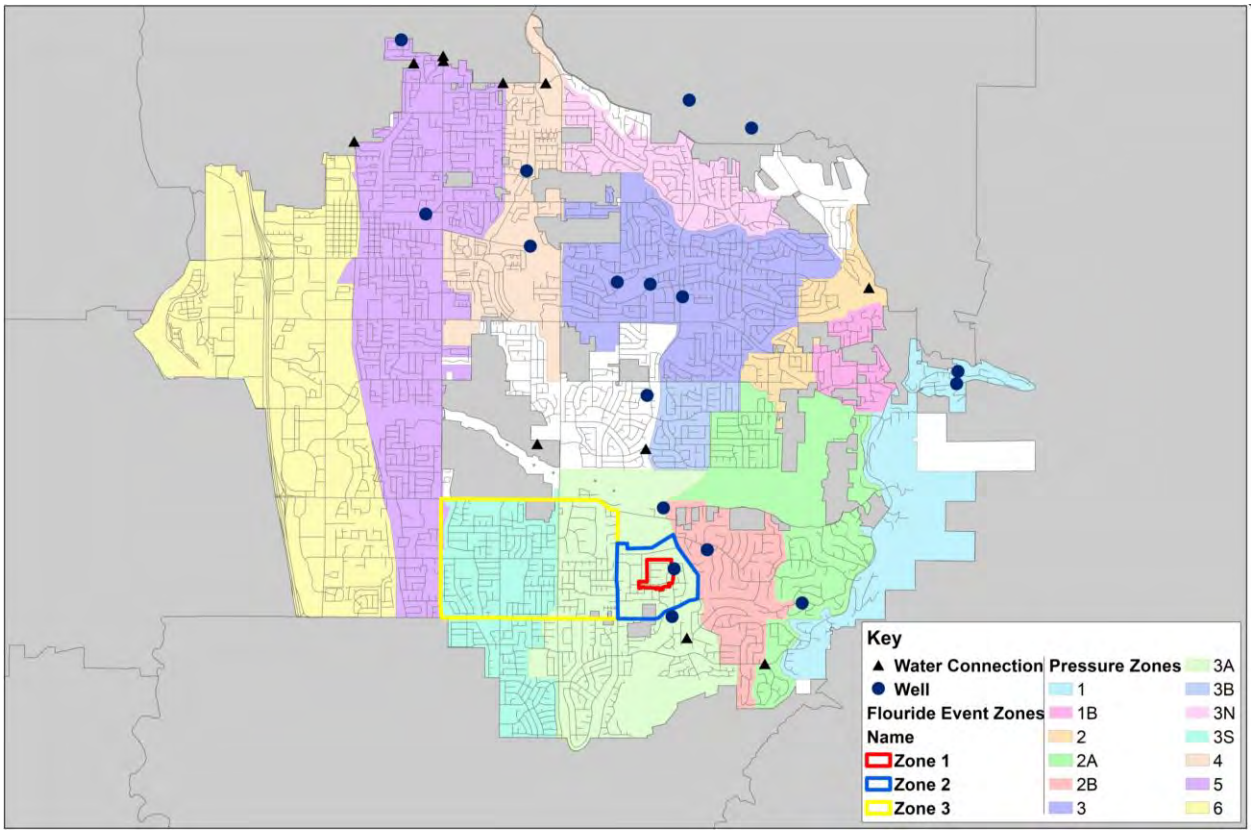


Figure 1-1: Overview map of Sandy City drinking water system.

WATER SOURCES

The City's water supply comes from a combination of wholesale water providers and City-owned groundwater wells as described below.

Wells

The City currently owns 16 groundwater wells (Table 1-1). Although the wells are usually used only for peaking and backup supply purposes, each well (with the exception of Paradise Valley which the City was ordered to shut down after the event) is operational and can supply water at any time if needed. No wells were operating at the time of the fluoride overfeed.

Table 1-1: Existing Wells

Well Name	ID #
Alta Canyon	WS028
Bicentennial	WS021
Big Canyon	WS006
Brandon Park	WS031
Canyon Village	WS018
Dimple Dell	WS032
Granite Mesa	WS004
Little Cottonwood	WS026
Lone Hollow	WS034
Palmer	WS015
Paradise Valley	**WS035**
Pepperwood	WS030
Robinson	WS010
Severson	WS012
Small Canyon	WS007
Wildflower	WS023

Wholesale Water Providers

Wholesale water has historically been purchased from two providers, Metro and JVWCD. Since the City's involvement with Metro beginning in 1990, the amount of water purchased from JVWCD has steadily decreased. The City's contractual relationship with JVWCD ended in 2001, and the City has not purchased water from JVWCD since 2009. Any use of JVWCD water is now limited to emergencies only.

As stated above, water from Metro has become the primary source of supply, while groundwater sources are supplemental to meet demands during peak months or in an emergency. Treated water from Metro is received at three entry points to the distribution system through the Point of the Mountain Aqueduct (POMA):

- POMA meter vault at Little Cottonwood Water Treatment Plant (LCWTP) (LCWTP Connection).

- POMA connection at Sego Lily Drive (Sego Lily Connection).
- POMA connection located north of Wasatch Boulevard along the proposed Highland Drive corridor (Southeast Connection).

Hydraulic modeling results (Chapter 4) show that water supplied to the area affected by the fluoride overfeed originated from the LCWTP Connection and the Southeast Connection.

Connections with Other Water Systems

The City maintains one emergency supply connection with JVWCD and one emergency connection with White City Water Improvement District (WCWID). The City has six metered connections to provide wholesale water to Midvale. The City no longer routinely provides water to Midvale, but the connections are in place and could be used. None of these connections were being used at the time of the fluoride overfeed.

STORAGE

Sandy City currently has 37 million gallons of storage available in 9 tanks. These tanks range in age from new to 40 years old. Information about each tank has been provided in Table 1-2.

Table 1-2: Existing Storage Tanks

Tank Name	ID #	Pressure Zone	Nominal Size (million gallons)	Floor Elevation (feet)	High Elevation (feet)	Material
A-1	ST001	1	0.65	5500	5523	Concrete
Flat Iron	ST002	4	5	4786	4825	Concrete
Granite	ST003	2	5	5227	5245	Concrete
Granite Mesa	ST004	6	3	4622	4648	Concrete
Hand	ST005	3	4	5035	5062	Concrete
High Bench	ST006	1	4.5	5490	5526	Concrete
Pepperwood	ST007	2N	3	5226	5250	Concrete
Southeast	**ST008**	**3S**	**4**	**4961**	**4993**	Concrete
Zone 5	ST009	5	8	4693	4728	Concrete
Total			**37.15**			

The Southeast Tank provides storage for the area affected by the fluoride overfeed. However, the hydraulic model (Chapter 4) shows that before the fluoride overfeed, water from the tank did not reach the affected zones because water from POMA connections reach the area first. The hydraulic model shows water from the Southeast Tank did reach the area during the flushing performed by the water operators in response to the overfeed.

DISTRIBUTION

The City's distribution system is made up of a series of pipelines, booster pump stations, operational valves and pressure zones described below.

Pipelines

The City's distribution system is composed of pipelines up to 36 inches in diameter. Table 1-3 summarizes the total length of pipeline for each diameter. Table 1-4 summarizes the total length of pipeline for each material. Most of the pipelines are made of ductile iron or polyvinyl chloride (PVC). There are only a limited number of pipelines made of cast iron and high-density polyethylene (HDPE).

Table 1-3: Distribution System Pipeline Lengths

Pipeline Diameter (inches)	Total Length (feet)	Percentage of Network (by length)
Unknown	2,979	0.13%
2	523	0.02%
4	23,111	1.02%
6	663,890	29.38%
8	930,606	41.18%
10	245,568	10.87%
12	128,006	5.66%
14	431	0.02%
16	190,051	8.41%
20	67,316	2.98%
24	1,896	0.08%
30	1,503	0.07%
33	42	0.00%
36	3,827	0.17%
Total	**2,259,749**	**100**%

Table 1-4: Distribution System Pipeline Materials

Pipeline Material	Total Length (feet)	Percentage of Network (by length)
Ductile Iron	2,212,096	97.89%
Polyvinyl Chloride	41,895	1.85%
Cast Iron	4,120	0.18%
High-Density Polyethylene	1,532	0.07%
Galvanized Steel	106	0.01%
Total	**2,259,749**	**100**%

The distribution pipelines affected by the fluoride overfeed are all ductile iron and vary in size from 6 to 12 inches in diameter.

Laterals

Based on interviews with personnel who have been with the City since 1980, only copper laterals have been installed since 1980. The City implemented a lateral replacement program in the mid-1980's to replace all laterals made of galvanized steel. City personnel that participated in the replacement program state that all laterals that were replaced were galvanized steel pipeline. No lead pipeline was ever found.

Homes in the affected area were all constructed after 1970, and 147 homes were constructed between 1970 and 1980. As part of the Corrosion Control Study Plan located in Appendix E, the City may assess as many laterals as possible of the homes built before 1980 in the affected area to determine their material. Figure 1-2 shows the age of the homes and pipelines in the zone of influence determined in the Corrosion Control Study Plan.

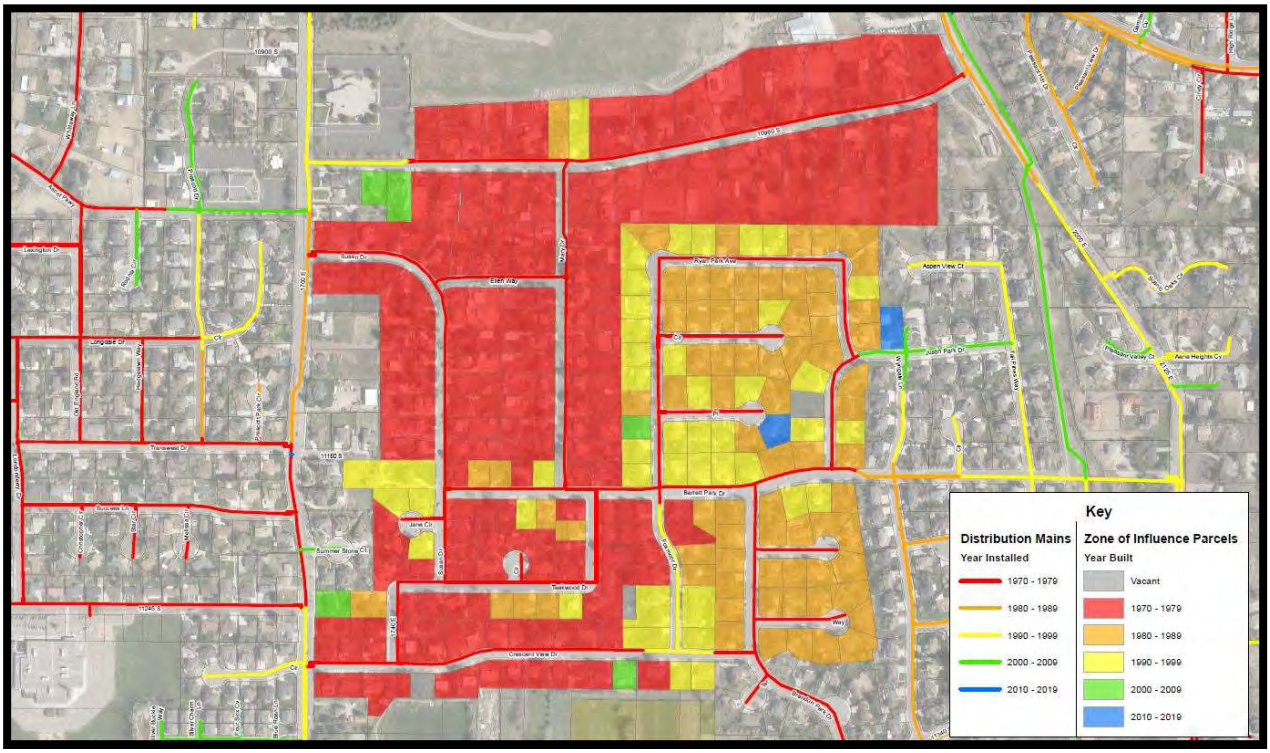


Figure 1-2: Age of the pipelines and homes in the affected area.

Plumbing

Interviews with the City's chief building inspector indicated that the use of galvanized pipelines in homes was phased out during the mid-1960's, and since then nothing but copper and plastic has been used inside of residential buildings. The use of solder containing lead was banned by the Safe Drinking Water Act Amendments of 1986. Homes in the affected area were all constructed after 1970, and 182 homes were constructed between 1970 and 1986. As part of the Corrosion

Control Study Plan, the City may check premise plumbing of the homes built before 1986 in the affected area to determine if lead solder is present.

Booster Pump Stations

Table 1-4 summarizes the capacities of the eight pump stations in the City's distribution system.

Table 1-5: Booster Pump Stations

Pump Station	No. of Pumps	ID #	Pressure Zone	Capacity (gpm)	Horsepower
#1	3	PS001	3 to 2	4,500	200
A-1	2	PS003	2 to 1	2,000	(3)-100
Granite Mesa	2	PS004	6 to 4	2,500	(1)-75, (1)-100
High Bench	2	PS005	2 to 1	1,500	(2)-125
Metro (Hand)	3	PS006	To 3	25,000	(3)-300
Metro (Granite)	3	PS007	To 2	4,500	(3)-250
Palmer	3	PS008	4 to 3	5,000	(1)-100, (2)-200
Pepperwood	4	PS009	3 to 2	9,000	(4)-300
			Total	**57,500**	

The Hand and A-1 pump stations were in operation at the time of the fluoride overfeed.

Operational Valves and Pressure Zones

Pressure zones in the distribution system are separated by pressure reducing or pressure sustaining valves (PRV's or PSV's).

The City has a total of 13 pressure zones (shown in Table 1-5). These zones are grouped into 6 major zones based on elevation (see Figure 1-1). Pressure Zone 1 is located at the highest elevation, on the eastern edge of the service area. Additional pressure zones are established as elevation decreases to the west, ending with Pressure Zone 6 on the western edge of the service area. Several of the pressure zones have also been divided into service sub-areas.

The Paradise Valley Well facility is located in Pressure Zone 3A. The western boundary of this zone runs along 1300 East, while the eastern boundary runs along High Mesa Road and continues along 2125 East to 2000 East (see Figure 1-1). The hydraulic model shows fluoride concentrations above the maximum contaminant level (MCL) of 4 mg/L moved west from the well until 1700 East, where it was diluted below the MCL. Sufficient sampling data is not available to conclusively determine that the area beyond 1700 East did not receive water above the MCL.

Table 1-6: Pressure Zones

Pressure Zone #	Static Hydraulic Grade Line (feet)
1	5520
1B	5400
2	5240
2A	5240
2B	5240
3	5050
3A	**4985**
3B	5100
3N	4965
3S	4970
4	4820
5	4710
6	4645

SUPERVISORY CONTROL AND DATA ACQUISITION

Each facility (well, pump station, storage tank) in the City's distribution system has a programmable logic control (PLC). The PLC receives input from sensors and measuring devices within the facility and, based on the programmed settings, adjusts the operation of the facility. The City's distribution system is also equipped with a Supervisory Control And Data Acquisition (SCADA) computer system. The PLC in each water facility is connected to the SCADA computer located at each site. Through the SCADA system, data is collected and viewed remotely, and changes to the facility operations can be made. Data is sent and received by radio signals through a network of antennas located throughout the City. The SCADA system may be accessed by authorized city personnel using mobile phones, tablets, or computers. The SCADA computer server stores all the data received from each water facility.

Like other facilities in the distribution system, the Paradise Valley Well facility has a PLC that controls the well pump and fluoride dosing pump and communicates with the SCADA system as described in Chapter 2.

WATER SOURCES AND TREATMENT

Sandy is a customer of Metro and receives treated, chlorinated and fluoridated surface water from Metro's two treatment plants. During peak months, the City uses its drinking water wells to help meet the demand. The general operational approach to water sources, treatment plants, and wells is summarized below.

Metro

Metro water supply is surface water from the Provo River, Little Cottonwood Creek, and Bell Canyon Creek. Water delivered from Metro is primarily treated at LCWTP. Treated water may come from the Point of the Mountain Water Treatment Plant (POMWTP) when it is online (usually during the summer months). Each treatment plant employs a different treatment process based on the water quality of its tributary sources. Water quality of the two Metro sources has been provided in Table 1-7.

Little Cottonwood Water Treatment Plant: Little Cottonwood Creek and Provo River are the two primary sources of water treated at the LCWTP. Water from Bell Canyon Creek may be commingled with water from Little Cottonwood Creek and treated at LCWTP.

Point of the Mountain Water Treatment Plant: Provo River water is the primary source of water treated at the POMWTP. Water from Battle Creek and Grove Creek may be commingled with water from the Provo River and treated at POMWTP.

Wells

Groundwater is supplied by the City's 16 wells. Several of the City's wells are equipped with chlorination and fluoridation treatment depending on the location and mixing ability of the well water with the distribution system water. Water quality of the City's groundwater wells has been provided in Table 1-7.

Table 1-7: Water Quality of Sandy City Water Sources

Contaminants	LCWTP	POMWTP	Wells	Unit
Primary Organics				
Chromium	5.39	6.33	15.6	ppb
Fluoride	0.6	0.5	0.2	ppm
Nitrate	0.24	0.22	1.7 – 3.8	ppm
Sulfate	34.3	37.5	33-35	ppm
Turbidity (annual average)	0.03	0.03	0.3-0.47	
Metals				
Arsenic	ND	ND	0.5-0.6	ppb
Aluminum	ND	10.6	NA	ppb
Barium	59	65.5	119-127	ppb
Selenium	ND	ND	1-1.11	ppb
Sodium	21.9	11.9	18.2-20.2	mg/L
Secondary Inorganic				
Chloride	31.9	29.7	NA	mg/L
pH	7.81	8.8	NA	units
Lead and Copper				
Lead	NA	NA	5.95	ppb
Copper	NA	NA	328	ppb
Additional Data				
Hardness as $CaCO_3$	113.6	130.3	NA	ppm
Alkalinity as $CaCO_3$	101.2	116	NA	ppb

Information taken from Salt Lake City and Sandy City 2018 Consumer Confidence Reports.

Wells with Chlorination or Fluoridation Systems

Of the City's 16 operating wells, five have both fluoridation and chlorination, seven have only fluoridation and four have no fluoridation or chlorination. Table 1-6 lists the 16 operating wells and their chlorination/fluoridation status.

Table 1-8: Well Chlorination and Fluoridation Status

Well Name	ID #	Treatment Plant ID #	Chlorination at Well?[1]	Fluoridation at Well?[2]
Alta Canyon	WS028	TP028	No	Yes
Bicentennial	WS021	TP021	Yes	Yes
Big Canyon	WS006	-	No	No
Brandon Park	WS031	TP031	No	Yes
Canyon Village	WS018	TP018	Yes	Yes
Dimple Dell	WS032	TP032	No	Yes
Granite Mesa	WS004	TP004	No	Yes
Little Cottonwood	WS026	-	No	No
Lone Hollow	WS034	TP034	No	Yes
Palmer	WS015	TP015	Yes	Yes
Paradise Valley	**WS035**	**TP035**	**No**	**Yes**
Pepperwood	WS030	TP030	Yes	Yes
Robinson	WS010	-	No	No
Severson	WS012	TP012	Yes	Yes
Small Canyon	WS007	-	No	No
Wildflower	WS023	TP023	No	Yes

1. Chlorine comes from sodium hypochlorite tablets.
2. Fluoride comes from hydrofluorosilicic acid.

The Paradise Valley Well facility only contains a fluoridation system.

SUMMER (PEAK) WATER SYSTEM OPERATIONS

During the summer months, the City receives over 90% (by volume) of its drinking water from Metro surface water sources. The City supplies the rest of its water through its wells. The City's average metered water usage during peak months (June, July, August) for 2016–2018 was about 51 million gallons per day (MGD).

WINTER (NON-PEAK) WATER SYSTEM OPERATIONS

During the winter months, the City typically receives all of its drinking water from Metro. During the week of February 3, 2019, the City's water usage averaged 7.2 MGD. This water usage is typical for January and February. These months are the lowest water usage months of the year.

CHAPTER 2 – CONDITIONS PRIOR TO AND DURING FLUORIDE OVERFEED

This chapter details the Paradise Valley Well facility and the conditions leading up to the overfeed. The chain of events was developed from SCADA records, PLC programming and audit logs, interviews of involved parties, independent experts in well design and fluoridation system design, and investigation of equipment in the well house.

PARADISE VALLEY WELL FACILITY

The Paradise Valley Well facility is located near Justin Park Drive in Sandy, Utah. The well house was constructed and placed in service in 2005. The well contains a fluoridation facility but does not currently have a chlorination facility. As required by county, state, and federal regulations, the well house contains a personnel safety shower and eyewash station.

When active, the well produces an average of 2,200 gallons per minute (gpm). In 2017 and 2018, the City did not use the Paradise Valley Well. Table 2-1 lists the months and years the well has been active and the total volume of water the well produced each year.

Table 2-1: Paradise Valley Well Annual Water Production

Year	Months Pumped	Total Volume (acre-feet)
2010	June, July, August, September	942.99
2011	August, September, October	586.26
2012	June, July, August, September, October	928.85
2013	None	0
2014	April, May, June, July, August, September	1350.30
2015	None	0
2016	June, July	345.17
2017	None	0
2018	None	0
2019	None	0

PARADISE VALLEY WELL FLUORIDATION FACILITY

The Paradise Valley Well fluoridation system (TP035) is housed inside of the Paradise Valley Well facility (WS035) (see Figure 2-1). 23% Hydrofluorosilicic acid is stored on site in a 1,000-gallon bulk acid solution tank. The bulk tank is equipped with a transfer pump that transfers the acid from the bulk tank to the 30-gallon day tank. To activate the transfer pump, an operator must physically press a button to start the transfer pump, then hold the button to keep the transfer pump running. Once the day tank is filled, the transfer pump shuts itself off even if the operator continues to hold the button, prohibiting any acid overflow from the day tank.

Plastic tubing connects the fluoride day tank to a calibration column. The calibration column is used by operators to determine the correct fluoride dosing pump setting to produce the appropriate dosing rate. Plastic tubing is used to connect the calibration column to the fluoride dosing pump. From the fluoride dosing pump, the tubing connects to a valve header which contains a pressure gauge. From the valve header, the plastic tubing connects to the main water line through a ball valve and injection nozzle.

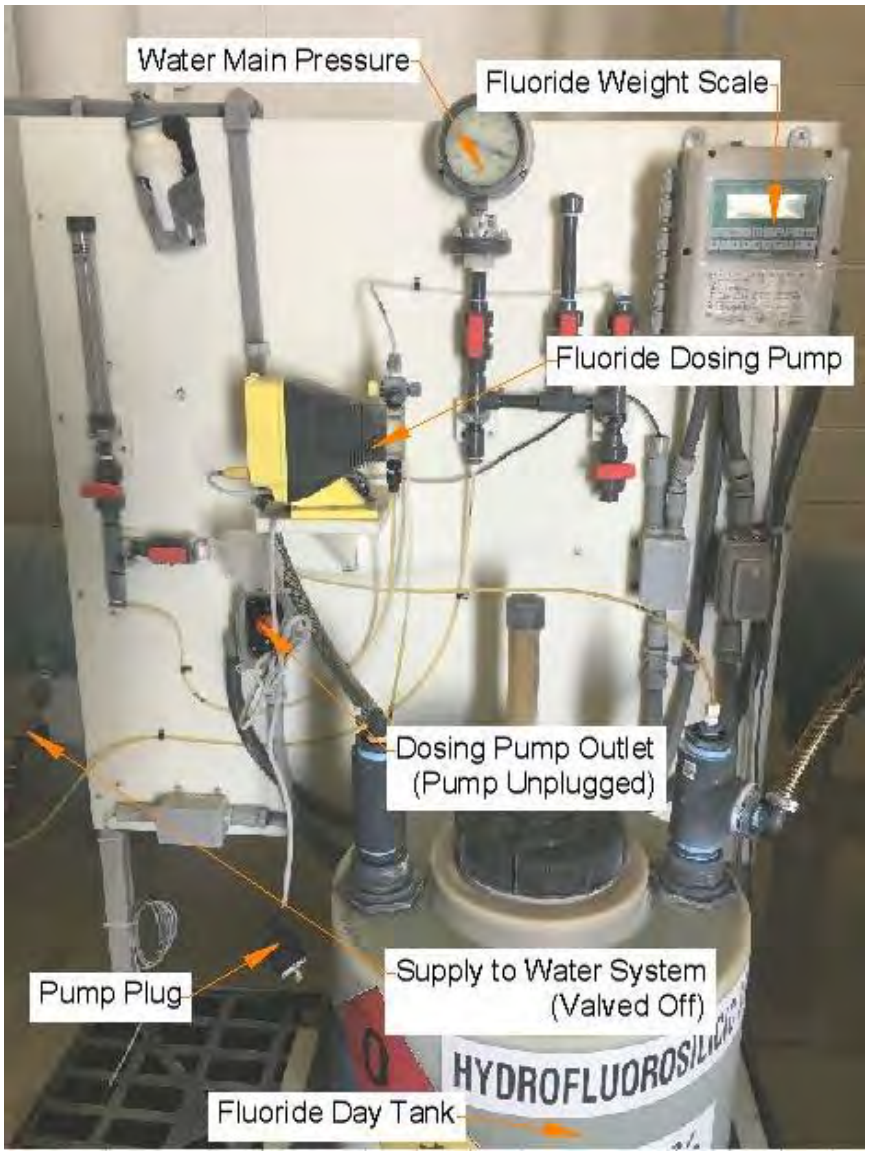


Figure 2-1: Fluoride equipment at the Paradise Valley Well facility.

Design drawings of the fluoridation system have been provided in Appendix B.

PROGRAMMABLE LOGIC CONTROLLER

The fluoride dosing pump receives electrical power from an industrial-grade non-shrouded locking outlet. The electrical power of the outlet is controlled by a PLC located inside the control panel of the well house. The PLC continuously monitors the well flow, operational status, and various alarm sensors to make decisions based on its programming.

The control panel has an uninterruptible power supply (UPS) which is used to protect the PLC from voltage transients and provide continuous power to the critical control components of the facility. In the event of a power failure, the UPS provides several minutes of battery power to the control panel.

The Paradise Valley Well facility's PLC included a fluoride control that had three settings to regulate electrical power to the industrial-grade non-shrouded locking outlet:

- AUTO: When the well is active, the operator sets the control to "AUTO," which only allows electrical power to the special outlet if the well is pumping water. If the well stops pumping water, electrical power to the special outlet that provides power to the fluoride dosing pump is automatically cut, and the fluoride dosing pump shuts down. In the "AUTO" mode, the fluoride dosing pump operates only when there is water flowing in the well discharge piping. Other conditions, described in the following section, must also be met before the fluoride dosing pump starts.
- OFF: When the well is inactive (e.g., during winter or other extended shutdown), the water system operator sets the control to "OFF," which cuts electrical power to the special outlet and prevents the fluoride dosing pump from running. In the "OFF" mode, the fluoride dosing pump is always off regardless of whether the well is pumping water or not.
- HAND: This setting allows continuous power to be supplied to the special outlet, thus allowing the fluoride dosing pump to run, regardless of whether the well is pumping water. Other conditions, described in the following section, must also be met before the fluoride dosing pump starts.

During interviews, operators indicated that the "HAND" setting was added after the well was constructed and was only intended for testing and priming of the fluoride dosing pump before putting the well into service. The AUTO/OFF/HAND control for the fluoride dosing pump is not a mechanical switch but rather a setting on the PLC touchscreen and in the SCADA computer. Although it was possible to activate the "HAND" setting remotely, the operators indicated that, as a practice, they do not. It was only used on site while testing and priming the fluoride dosing pump before use. (After the fluoride overfeed incident, the City removed the "HAND" setting from the SCADA computer both on-site and remotely for all fluoride dosing pumps in the distribution system. Currently, the only available settings are "AUTO" and "OFF.")

FLUORIDE DOSING PUMP LOGIC

Power to the fluoride dosing pump outlet is controlled by the PLC. In order for the PLC to energize the outlet in the “HAND” position, multiple conditions related to the fluoride facility must be met. These conditions include a minimum and maximum amount of fluoride in the day tank, no leaks in the fluoride day tank, and no flow through the shower/eyewash station. Each condition has been programmed into the logic of the PLC and is tied to a specific sensor in the Paradise Valley Well facility. In the “AUTO” position, all of these conditions must be met, plus the well flow meter has to be measuring flow in order for the PLC to energize the outlet.

The shower/eyewash condition was included in the logic since the use of the shower/eyewash station would suggest that a chemical problem had occurred and that the chemical system should be shut down immediately. For this reason, the shower/eyewash flow condition is monitored by a flow switch located on the water supply feed pipeline of the shower/eyewash station (Figure 2-2). The flow switch is triggered when there is enough flow through the feed pipeline to activate the paddle switch. Flow through the feed pipeline occurs when the shower or eyewash is used. Once activated, the switch sends an electrical signal to the PLC. The PLC logs a “shower/eyewash alarm” and opens the relay to the fluoride dosing pump outlet, de-energizing the outlet until an operator clears the alarm.

Sometime in the past, for unknown reasons, the visual alert for this alarm was removed from the PLC touchscreen and SCADA. City water system operators and controls engineers who have worked on the Paradise Valley Well facility reported they do not have record of why or when this alarm notification was removed.

Interviews with the current water system operator responsible for the supervision of the facility revealed that the operators run the shower and eyewash regularly to keep the water fresh. Examination of the flow switch operation by HAL engineers demonstrated that the flow switch can get stuck in the open (or flowing) position when the shower is used. (The shower produces enough flow to open the switch and activate the alarm, but the eyewash alone does not.) This jammed condition may have developed due to corrosion or debris holding the spring in a locked position. Figure 2-3 provides a section view of the switch. The switch can be released into the closed position by tapping on the switch.

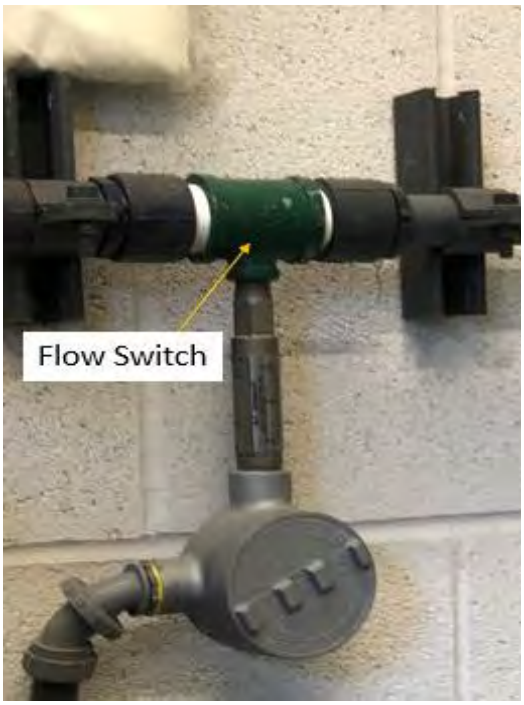


Figure 2-2: Photo of the Shower/Eyewash flow switch.

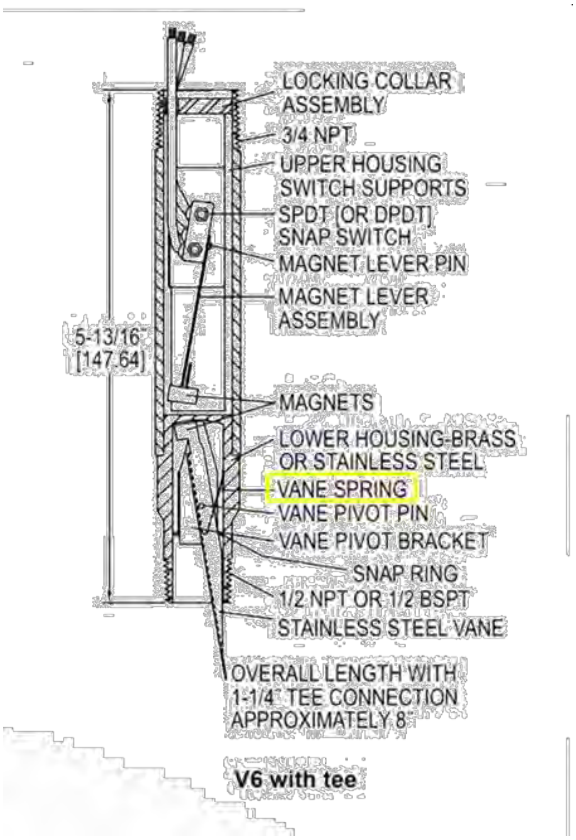


Figure 2-3: Section view of the Shower/Eyewash flow switch.

After the incident, a forensics examination revealed the following:

- Between July 2016 and December 19, 2018, the water system operator responsible for the Paradise Valley Well facility had turned on the shower multiple times and thereby triggered the shower/eyewash flow switch (July 2016 was the last time the well pumped water; see Table 2-1).
- The flow switch became stuck in the open/flowing position.
- The activated flow switch sent an alarm to the PLC that cut power to the fluoride dosing pump's special outlet.
- Operators were unaware of the alarm because the visual alarm notification had been removed from the SCADA computer and the PLC.

Figure 2-4 is a screenshot of the PLC logic before December 19, 2018. The figure shows the fluoride dosing pump energized through all switches except the shower flow alarm.

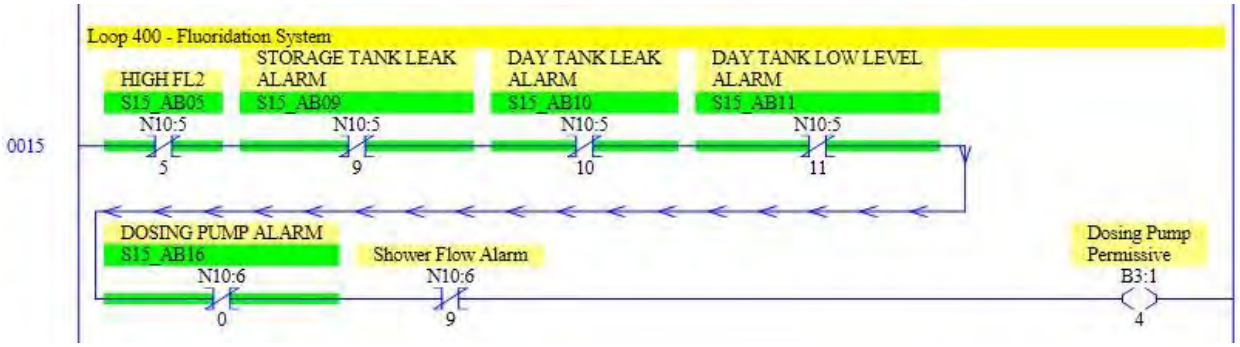


Figure 2-4: PLC logic before the incident
(Highlighted switches are energized)

SCADA UPGRADE WORK ON DECEMBER 19, 2018

On December 19, 2018, an outside contractor hired by the City began upgrading the SCADA hardware at the Paradise Valley Well facility. The upgrade involved replacing the old PLC with a new PLC. A conversion tool was used to transfer the old logic to the new PLC, eliminating the need for reprogramming of the PLC. Interviews with the SCADA contractor revealed that the active instance of the shower/eyewash alarm would not have been transferred to the new PLC. Therefore, when the PLC was changed, the flow switch was still stuck in the open/flowing position, and reinitialized the alarm.

During the upgrade, the fluoride dosing pump control setting was changed from "AUTO" to "HAND." Interviews with the contractor confirmed that the pump was in "HAND" when the contractor returned to the site after the event.

CLEARING OF ALARMS

In the event of a communication loss for more than 30 minutes between the well PLC and main SCADA computer, the main SCADA computer activates a communication alarm. The on-call

water system operator receives a notification that the main SCADA computer has lost communication with the well PLC. The operator can acknowledge the alarm remotely on a phone or tablet. Once communication is restored to the PLC at the well, the main SCADA computer clears its own alarm and receives a local communication alarm from the PLC at the well. This local alarm cannot be cleared remotely on a phone or tablet. It must be acknowledged and cleared at the well PLC panel or at the main SCADA computer.

After December 20, 2018, when the fluoride pump was switched to "HAND," the PLC was preventing the fluoride pump outlet from energizing because the shower/eyewash flow switch was stuck in the flow position and the shower/eyewash alarm was active. SCADA logs show that several times between December 20, 2018, and February 4, 2019, local communication alarms were cleared by water system operators. There is only one clear alarm command; all alarms at the PLC are cleared when any alarm is cleared. The PLC setup does not allow the clearing of individual alarms.

According to SCADA logs, the last time a local communication alarm was acknowledged and cleared without the fluoride dosing pump turning on was January 27, 2019.

On January 27, 2019, the shower/eyewash flow switch was still stuck in the flow position. When the clear alarm command was sent, the flow switch immediately re-activated the hidden alarm and kept the fluoride dosing pump from turning on. This was confirmed by recorded well site visits by water system operators. The fluoride dosing pump is very loud and can be heard outside of the well house. When operators visit the wellhouse they not only go in the building to sign the log but also open the fluoride equipment room.

The last time an operator visited the well and can verify the fluoride dosing pump was not on was the morning of February 4, 2019. Sometime after the last alarm was cleared on January 27, 2019, the shower/eyewash flow switch returned to the closed (no flow) position. At that point in time, only the shower/eyewash alarm was preventing the PLC from energizing the fluoride pump.

SUMMARY OF CONDITIONS PRIOR TO EVENT

In summary, the following were the conditions at the Paradise Valley Well immediately before the overfeed event that started on February 5, 2019:

- The well was not running (and had not run since July 2016).
- The fluoride dosing pump was not running.
- The fluoride dosing pump control had been set to "HAND" by the contractor since SCADA upgrades on December 19, 2018. The "HAND" position was shown on an obscure PLC menu screen. With the well offline and the fluoride dosing pump not running, operators had no reason to suspect the control was set to HAND.
- The shower/eyewash flow switch had been stuck in the open or flowing position, even though no water was flowing, until at least January 27, 2019. Operators had no indication that the flow switch was faulty.

- Even after the flow switch returned to the closed position, the shower/eyewash alarm was still active and was withholding power from the fluoride dosing pump. The alarm notification was not visible on the PLC or SCADA screen. Operators had no indication that this particular alarm was active.

FLUORIDE DOSING PUMP TURNS ON

The following timeline describes the communication fault leading up to the fluoride dosing pump turning on.

February 4, 2019

- **10:37 AM** – Operator visits site and confirms fluoride dosing pump is not running (stated above)
- **11:14 PM** – The City's main SCADA computer lost communication with the Paradise Valley Well facility PLC.
- **11:44 PM** – After 30 minutes of no communication between the well's PLC and the main SCADA computer, an alarm was triggered at the main SCADA computer to alert the on-call operator of the loss of communication. (Figure 2-5)
- **11:46 PM** – The on-call operator acknowledged the alarm on his cell phone.

February 5, 2019

- **12:21 AM** – Communication was restored between the main SCADA computer and the Paradise Valley Well facility PLC. At this time a local communication alarm was received from the facility PLC.
- **6:54 AM** – The on-call operator acknowledged the alarm at the main SCADA computer located at the Sandy City Public Utilities (SCPU) operations building.
- **6:57 AM** – The on-call operator cleared the local communication alarm from the main SCADA computer.

The clearing of the local communication alarm from the main SCADA computer results in a clearing of all alarms from the well's PLC. Therefore, because the shower/eyewash flow switch had returned to its closed position by then and was no longer triggering an alarm, the shower/eyewash alarm was cleared along with the local communication alarm. Once the alarm was cleared, all logical conditions were satisfied. The special outlet was energized and the fluoride dosing pump started running.

2/5/19 12:21 AM		S15 - Paradise Comm Fault	0	Clear
2/4/19 11:46 PM	Brian	S15 - Paradise Comm Fault		Ack
2/4/19 11:44 PM		S15 - Paradise Comm Fault	1	Active
2/5/19 6:57 AM		S15 - Paradise Local Comm Fault	0	Clear
2/5/19 6:54 AM	Brian	S15 - Paradise Local Comm Fault		Ack
2/5/19 12:21 AM		S15 - Paradise Local Comm Fault	1	Active

Figure 2-5: SCADA log showing communication alarm activity on February 4–5, 2019.

Interviews with the water system operator responsible for the facility confirmed that the fluoride dosing pump would still have been ready to pump from the last time the well ran in July 2016, since the well was never officially shut down and could have run any time if needed. The fluoridation system flow valves were not modified and the fluoride solution was not removed from the tubing. Once the fluid is removed from the tubing it takes considerable effort for the operator to prime the fluoride dosing pump. The fluoride dosing pump sits above the day tank and cannot prime itself. The fluoride dosing pump would not be able to pump the fluoride solution from the day tank to the distribution system if any valves were modified from the normal operation run positions.

Consultation with the fluoridation system designer, well house design engineer, and the water system operators confirmed that the fluoride dosing pump, after sitting idle for two and a half years, may still have taken a long period of time to start moving the fluoride solution from the day tank to the distribution system due to working conditions of the foot valve in the day tank, the seals in the pump, and any small air bubbles in the plastic tubing. Therefore, it is assumed that after turning on at about 6:57 AM on February 5, 2019, the pump ran for about 11 hours before pumping the fluoride solution into the 12-inch discharge pipeline that runs from the Paradise Valley Well facility to the 8-inch-diameter water main in Justin Park Drive at approximately 6:40 PM on February 5, 2019. SCADA system records show the fluoride day tank scale weight beginning to drop at this time (see Appendix A).

HOW FLUORIDE REACHED THE DRINKING WATER SYSTEM

The SCADA system shows that 140 lbs. (14 gallons) of 23% hydrofluorosilicic acid was pumped into the distribution system. Because the fluoride dosing pump was calibrated to maintain 0.7 mg/L (ppm) of available fluoride to the water system, the fluoride dosing pump was pumping at a rate of 0.006 gpm from 6:40 PM on February 5 to 1:45 PM on February 7, when it was discovered running and shut off.

In the “AUTO” position the fluoride dosing pump only operates when the well is pumping water. The well pump moves the water quickly in the 12-inch diameter discharge pipeline between the well and the 8-inch diameter water main in Justin Park Drive. The fluoride fully mixes at the proper concentration and is pushed into the distribution system. When the well is not pumping there is no movement of water from the wellhouse to the distribution system.

During the incident, the well pump was off and no water was being pumped from the well, though the discharge pipeline was full of water from the distribution system. Unfortunately, the discharge pipeline slopes downward toward the street. Once in the well discharge pipeline, the hydrofluorosilicic acid, which is a liquid that is 20% denser than water, displaced the water in the pipeline, sunk to the bottom of the pipeline, and worked its way down the well discharge pipeline to the water main by gravity. The fluoride hydraulic model (described later) predicts it took 16 hours for the fluoride solution to reach the water main in Justin Park Drive where it mixed with and was carried by the flow in the pipeline.

CHAPTER 3 – TIMELINE

This chapter chronicles, in detail, events occurring from February 5, 2019, to February 18, 2019. The information presented herein was compiled from documented communication and from interviews with the persons involved. At the end of this chapter, continuing efforts are summarized. A presentation timeline created by the City after the event has also been provided in Appendix G.

Tuesday, February 5, 2019

- **6:57 AM** – A local communication alarm was cleared at the SCPU operations building on the main SCADA computer. With the clearing of the alarm, the fluoride dosing pump began running. For conditions leading up to this time, see Chapter 2.
- The daily site visit was not conducted due to department-wide flagger certification training.
- **6:40 PM** – After running for 11 hours, the fluoride dosing pump began injecting the fluoride solution into the 12-inch diameter well discharge pipeline at a rate of 0.006 gallons per minute.
- That evening, an unusually strong winter storm impacted Sandy, bringing between 12 and 15 inches of snow to the Paradise Valley Well site.

Wednesday, February 6, 2019

- On the morning of February 6, 2019, the winter storm continued to impact the City, causing the mayor to close City Hall.
- **7:29 AM** – Non-essential employees were given the day off, and those employees already at work were instructed not to drive due to the unsafe road conditions.
- The water operator responsible for the daily inspection of the Paradise Valley Well facility was sent home early, and no inspection was performed that day.
- **4:47 PM** – The Sandy Fire Department received a complaint in the area of “caustic” tasting water.
- **4:52 PM** – Dispatch notified SCPU of the complaint.
- **4:56 PM** – SCPU contacted the resident by telephone and suggested the concern may be related to a water softener. The resident responded that they did not have a water softener and hung up.

Thursday, February 7, 2019

- **2:03 AM** – The Sandy Fire Department was dispatched in response to another complaint of bad tasting water at a location near the first complaint. The Fire Department responded but was “unable to detect anything wrong with the water by smell and taste” and instructed the homeowner to contact the water department in the morning.
- **8:00 AM –** The City’s Compliance Officer arrived at work to find a note related to the complaint at 2:03 AM.
- **Approximately 8:30 AM** – The Compliance Officer contacted Metro to determine if there was a problem with the water being supplied.

- **9:00 AM** – The City's Water System Supervisor and Compliance Officer visited two homes in the area to begin investigating the complaints. The Water System Supervisor tasted the water at one of the homes and recognized a water quality problem.
- **Approximately 9:30 AM** – The City's Compliance Officer went to Metro to collect empty sample bottles and was informed that Metro could not find any issues with its own water. Metro recommended a full suite of minerals and metals testing to determine the issue. What tests to be included in the full suite of metals and minerals was not specified. Once the bottles were collected, the Compliance Officer proceeded to the area from which the complaints had originated.
- **10:00–11:35 AM** – SCPU received seven more complaints from homeowners in the same area as the two earlier complaints, including one of a baby who had ingested formula made with what the parents described as metallic-tasting water. The City's Engineering Manager followed up with the family that day, and continued to provide assistance over the next several days.
- **Approximately 10:35 AM** – Because there had been no calls from homes located to the east of the Paradise Valley Well facility, the on-call operator was asked to verify that the well had not turned on. The operator confirmed that the well was not on by looking at the SCADA system. The SCADA system is not programmed to display the status (on/off) of the fluoride dosing pump; therefore, the operator was unable to see that the fluoride dosing pump was running.
- **10:40 AM –** The City's Compliance Officer took samples from three locations (hose bibs from two houses and one fire hydrant). Two investigative samples for metals testing were taken at each location 15 minutes apart, along with an investigative sample for minerals testing at each home and a bacteriological sample at each location. The two houses were chosen based on complaint reports received earlier in the morning.
- **11:47 AM–1:30 PM** – Once the samples were taken, City water system operators began flushing hydrants in the area where they had received the complaints.
- **1:43 PM** – After finishing their routine sampling, the City's Compliance Officer stopped at the well to ensure nothing was wrong. The compliance officer entered the well and discovered that the fluoride pump was running. Upon discovery, the Compliance Officer unplugged the pump. The water system operator responsible for the Paradise Valley Well facility was contacted.
- **1:48 PM** – The Water System Operator responsible for the well arrived and closed the valve on the feed line from the fluoride dosing pump to the 12" diameter well pipeline.
- **Approximately 2:00–4:30 PM** – After shutting down the pump, water distribution staff closed valves and began unidirectional flushing to pull as much of the contaminated water as possible back towards the well. Analysis of tank levels from SCADA showed approximately 180,000 gallons were flushed on February 7.
- **Approximately 2:15 PM** – The City's Compliance Officer went to the Metro laboratory to have the laboratory staff conduct a quick fluoride test using a portable instrument because the laboratory instrument was unavailable.

- **Approximately 2:15 PM** – City staff called the water quality and hazardous waste supervisor of the Salt Lake County Health Department (SLCoHD) to notify them of the event. The City was unaware of the levels of fluoride concentration at the time.
- **Approximately 2:45 PM** – Metro verbally informed the City's Compliance Officer that the preliminary test result from the quick fluoride test was 104 mg/L (26 times the primary MCL of 4 mg/L).
- **3:22 PM** – The City's Compliance Officer turned in a chain of custody (Appendix H) to Metro requesting metals testing for the six investigative samples and minerals testing for the two investigative samples taken earlier, as recommended by Metro. The Compliance Officer also requested pH and fluoride testing on four of the samples.
- Once alerted of the high levels of fluoride, water system operators began conducting door-to-door notifications to notify people of the event and instruct them to flush the piping in their home. The area of notification was left to the discretion of the employees, and no record was kept of which houses were notified.
- After being informed the fluoride pump had been in operation, SCPU Engineering Manager began using a previously prepared winter scenario hydraulic model to trace the extent of the water originating from a location near the Paradise Valley Well facility. The model provided information on the possible geographic extent of elevated fluoride levels in the system.
- **Approximately 4:30 PM** – After the distribution system flushing was believed to be complete, the City took two additional fluoride samples, one from the well and one from the fire hydrant sampled earlier in the day. These field test results revealed fluoride levels of 0.78 mg/L (well) and 1.10 mg/L (hydrant).
- **Approximately 4:48 PM** – The City's Operations Manager sent SLCoHD's Environmental Health Scientist a text message reporting:
    - "…Preliminary sample results indicate about 104 mg/L…"
    - "…affected residents have been contacted and are doing well…"
    - "…The baby that went to the doctor yesterday is doing good today…"

Friday, February 8, 2019

- **Approximately 10:30 AM** – City staff contacted the Utah Division of Drinking Water (DDW) to inform them of the fluoride event.
- **Approximately 10:45 AM** – DDW's Emergency Response Coordinator called the City's Water System Supervisor to get more information. During the call, the City's Water System Supervisor explained the following:
    - The fluoride overfeed started on February 5, 2019 around 6:40 PM, as verified by SCADA records showing a drop in the fluoride day tank levels starting at this time.
    - The 30-gallon fluoride day tank was pumped over the next approximately 44 hours.
    - The well was not physically checked on February 6, 2019, because a snow storm kept crews off the roads and half the crew was sent home.
    - Sample results indicated fluoride concentrations of 104 mg/L.
    - Water operators had turned off the fluoride dosing pump and flushed the distribution system.

- **Approximately 11:30 AM** – A conference call between the City and DDW was held (Rules Manager, Environmental Scientist, and Emergency Response Coordinator of DDW; Water System Supervisor of the City). During this call:
    - DDW requested the City run complete "inorganics and metals." DDW recalls that the samples were requested to be rushed.
    - The City informed DDW they had requested "metals and minerals" testing for the investigative samples collected on February 7.
    - DDW recalls directing the City to collect extensive field samples in order to define the perimeter of the impacted area.
    - DDW informed the City they would need to provide a Tier 1 public notice, which would be drafted by DDW and sent to the City by 1:00 PM.
- **Approximately 1:00 PM** – Another conference call between the City and DDW was held (Director, Emergency Response Coordinator, and Administrative Assistant of DDW; Public Utilities Director and Water System Supervisor of the City) in which:
    - The City informed DDW they had used the Metro laboratory for samples.
    - The City informed DDW that they had backflushed the well, closed the valve on the feed line from the fluoride dosing pump to the 12" diameter well pipeline, and performed unidirectional flushing through the hydrants.
    - The City sampled the well site after the flushing and the levels were back to normal.
    - The City created a sample perimeter based on customer complaints.
    - DDW requested a narrative of the event and map of the perimeter based on field tests to ensure everyone affected was notified.
- **2:05 PM** – The city sent DDW a map of the proposed notification area, which included 59 homes. At this time the city estimated 24 to 30 homes were affected based on the water quality complaints, reports of illness, field sampling, and the interpretation of the initial model results.
- **4:00 PM** – Water system operators took fluoride samples to the north, south, east, and west of the well to identify the perimeter.
- **4:36 PM** – The City received the draft public notice from DDW.
- **Approximately 5:00 PM** – A conference call between the City, DDW, and SLCoHD (Director and Emergency Response Coordinator of DDW; Public Utilities Director, Water System Supervisor, and Operations Manager of the City; Environmental Health Director of SLCoHD) was held to discuss the public notice and the notification area:
    - DDW told the City that the "box" on their map was not large enough and that they needed to expand the area to anywhere the water could travel, not just where the computer model showed. In response to this request, the City enlarged the area to 89 homes. The new notification area was based on initial hydraulic modeling results, customer complaints and sampling test results.
    - DDW verbally informed the City to use all of the approved language and not remove any content. The City was allowed to add a paragraph and place the public notice on the City's letterhead.
    - The City confirmed they would hand-deliver the public notice to residents that evening and provide a final copy to DDW.

    - The City was verbally instructed to provide the final public notice, a perimeter map of those receiving the public notice (including how many residents actually received the notice), a written report of the event, a specific timeline of actions taken after customer complaints began, responses to the complaints, information on their website about the incident, and all associated laboratory data as soon as possible. DDW also recalls requiring additional sampling during this call.
- After the City received the public notice from DDW, changes were made including the removal of the following language: "Corrosive water may cause damage or irreparable impacts to the water system in your home including: pipelines, hot water tanks, filters, and water softeners."
- When the City put the DDW language on the City's "Notice of Recent Drinking Water Quality Event" form, the City failed to copy over the DDW headings "Drinking Water Warning" and "Do Not Ingest Warning."
- **5:37 PM** – The revised public notice was sent back to DDW and SLCoHD.
- **6:05 PM** – DDW acknowledged they had received the revised public notice.
- **6:15 – 7:00 PM** – The public notice was distributed to the area now known as Zone 1, which included 89 homes.
- **7:56 PM** – The City emailed the field fluoride results taken earlier that day to DDW. The sampling results were sent on a form that did not specify fluoride results.

Saturday, February 9, 2019

- The Water System Supervisor for the City received a call from a homeowner inquiring about the fluoride event. The Water System Supervisor's phone number was provided on the public notice from February 8 for anyone who had questions, concerns, or illness reports.
- The Water System Supervisor for the City backflushed the Paradise Valley Well for approximately 1.5 hours.

Sunday, February 10, 2019

- The Water System Supervisor for the City received a call from a homeowner inquiring about the fluoride event.

Monday, February 11, 2019

- **1:00 PM** – A conference call was held between the City, DDW, and SLCoHD (Director, Assistant Director, Environmental Scientist, Emergency Response Coordinator, and Administrative Assistant of DDW; Public Utilities Director, Water System Supervisor, Operations Manager, Engineering Manager, and Business Manager of the City; Bureau Manager, Water Quality and Hazardous Waste Supervisor, Environmental Specialist, Environmental Health Scientist, and Assistant Director of Environmental Health of SLCoHD). During the call, the following information and instruction was provided:
    - On Tuesday night (February 5) a power outage occurred. When power was restored, the fluoride pump turned on. (Note this is not entirely accurate; see Chapter 2.)
    - The City had unplugged all fluoride pumps in their distribution system.

    - The City receives all of its water from Metro during the winter months. No wells were in use during the event.
    - The City visits its wells every work day even when they are not running.
    - The locations where the highest values of fluoride were originally discovered were now testing close to normal in field tests.
    - DDW instructed the City to run a full metals suite on the samples from February 7.
    - The City confirmed they had delivered metal samples to Metro on Thursday, February 7, and were waiting on the metals results.
    - DDW and SLCoHD requested daily fluoride sampling outside the initial perimeter. It was suggested that the City take 1–2 dozen samples per day until confidence could be determined. DDW also requested additional metals sampling to ensure system stabilization.
    - The City was ordered to describe the perimeter of the event within 48 hours.
    - DDW informed the City that the protective scale layer may have been stripped from the inside of the distribution network piping and interior plumbing, and stabilization needed to be demonstrated.
- After the meeting, the Water System Supervisor checked on the status of the requested samples. Due to equipment and staffing issues, Metro was unable to run the samples.
- **2:02 PM** – Metro delivered the samples to Chemtech-Ford Laboratories, where Metro requested a two-day expedited analysis for lead and copper.
- The City flushed and collected fluoride field samples.

Tuesday, February 12, 2019

- **7:26 AM** – The City's Water System Supervisor emailed DDW's Emergency Response Coordinator the set of field fluoride tests taken on February 11 on a chlorine residual form. After discussion with the Water System Supervisor, DDW's Emergency Response Coordinator was informed the samples were in fact fluoride samples.
- DDW served the City a "cease operation" notice for the Paradise Valley Well.
- Later that evening, the City held a City Council meeting where a resident reported that their neighbor, someone who resided outside of Zone 1, had suffered illness and had not received a notification.
- The City flushed and collected fluoride field samples during the day.

Wednesday, February 13, 2019

- **8:00 AM** – The Public Utilities Director called the affected resident, who said she drank several bottles of water and suffered gastrointestinal issues while exercising on Saturday, and that she felt better on Sunday.
- The City's Engineering Manager checked the hydraulic model to see if elevated concentrations may have reached the area of the home of the affected resident. The model's trace simulations showed some of the contaminated water may have reached the western boundary of what later became known as Zone 2. Additional model results provided by Hansen, Allen & Luce, Inc., a private engineering firm familiar with the City's distribution system, showed fluoride concentrations above 20 ppm beyond the boundary of Zone 1.

- The City reviewed the distribution list for the public notice sent out on February 8 and identified that not all residents in the affected areas had been contacted face to face. Based upon this and the refined hydraulic model results, the City decided to re-issue its public notice and to expand the area of notification to include Zone 2.
- **11:30 AM** – A conference call between the City, DDW, and SLCoHD (unknown participants) was held, in which the following was discussed:
    - The City informed DDW that a resident outside of Zone 1 who had not been notified became ill. Also, hydraulic model results showed fluoride concentrations above 20 ppm beyond the boundary of Zone 1. As a result, the public notice from February 8 was going out again and the notification area was expanding to include the recently formed Zone 2.
    - The City explained how the first public notice was distributed to Zone 1 residents. Operators knocked on doors and left a flyer if the resident did not answer.
    - DDW emphasized the need for submitting more sample results.
    - DDW informed the City that the EPA was aware of and monitoring the situation.
- DDW expressed concerns to the City regarding the efficacy of this notification method due to the reverse 911 only reaching landlines.
- DDW informed the City they would need to provide the initial public notice from February 8 to all residents in Zone 2. DDW also renewed its request for a map showing which homes would be receiving the public notice, laboratory results of all testing that had been done, a specific timeline of events, and a complete narrative of the event.
- **2:50 PM** – The City's Public Utilities Director sent an email to the Director of DDW and the Bureau Manager at SLCoHD containing the following information:
    - A map of the original notification area from February 8 showing which homes were visited, who reported sickness, which residents were not home, and which homes received the flyer.
    - A map of the notification area for the February 13 public notice.
    - A copy of the water quality and illness survey being provided to residents in the notification area by City staff.
- **3:39 PM** – Chemtech-Ford sent the lead and copper results from the February 7 samples to Metro. The email initially went to Metro's junk mail, which caused a delay between the initial email and the City receiving the results.
- **3:55 PM** – The City's Compliance Officer received an email from Metro containing the pH results for the samples taken on February 7.
- Later that afternoon, the City conducted door-to-door notifications in Zone 1 and Zone 2. The same February 8 public notice was used; however, language was added which specified running all hot and cold water taps for 30 minutes.
- The City flushed, collected fluoride field samples, and submitted results from the previous day.

Thursday, February 14, 2019

- **9:06 AM** – The City's Water System Supervisor sent DDW's Emergency Response Coordinator a list of the homes reporting illness from February 7.

- **11:47 AM** – DDW Emergency Response Coordinator emailed the City's Water System Supervisor and Public Utilities Director a list of requests and requirements that had been made from February 8 to February 14 that had not yet been provided.
- **1:38 PM** – Metro emailed the laboratory results to the City's compliance officer. The results showed elevated levels of lead and copper. A formatting discrepancy and concern over uncertified results led to a delay between the time the City received the results and when the City reported them to DDW. Results above an MCL or Action Limit are normally flagged as red in color as an acknowledgement by the lab that the results are correct; however, this report did not show the elevated levels in red. The City worked to resolve the discrepancy with Metro and Chemtech-Ford.

Friday, February 15, 2019

- **9:57 AM** – The City sent the investigative laboratory results to DDW of samples taken prior to flushing on February 7 showing elevated levels of lead (0.394 mg/L) and copper (28.8 mg/L). DDW also received:
    - The results of February 13 pH testing which showed pH levels for 12 locations ranging from 6.7 to 7.2.
    - Fluoride sample results for February 13 for 11 locations ranging from 0.59 mg/L to 1.07 mg/L.
    - Fluoride sample results for February 14 from 12 locations ranging from 0.68 mg/L to 1.02 mg/L.
    - A notification area maps for Zones 1 and 2.
    - A pressure zone map showing the potential contamination area may not have been confined to 1700 East.
- **1:20 PM** – The City's Compliance Officer took metals samples from the two houses sampled on February 7.
- **1:30 PM** – The City and DDW met at City Hall to discuss the results and further actions:
    - DDW alerted the City that MCL for fluoride and the public notice violations had been placed on their record and reported to EPA.
    - DDW provided the City a draft copy of the Administrative Order requiring them to sample every home in Zone 1 and Zone 2 for lead and copper. The City was also informed that it had not yet provided all the data DDW had requested previously.
    - DDW required that the City provide a new public notice for lead and copper to residents inside Zone 1 and Zone 2 that day.
    - The City explained they had taken follow up metals samples at the two houses with high metals results on February 7 and were expecting results on Monday, February 18.
- DDW's Emergency Response Coordinator provided a list of required sampling for metals and pH.
- Due to hydraulic model results showing possible 2 mg/L east of 1300 East, and to provide a conservative buffer area that included schools and was demarcated by easily recognizable street boundaries, the City decided to expand the notification area to include the newly formed Zone 3.

- **2:00 PM** – The City's Compliance Officer delivered the metals samples to Chemtech-Ford and requested lead and copper tests on a two-day rush.
- **5:30 PM** – A press conference was held at Sandy City Hall (Mayor and Public Utilities Director of the City; Director of DDW). The press conference covered the following:
    - Laboratory results had shown high levels of lead and copper prior to flushing on February 7.
    - Based upon pH, fluoride, and chlorine sampling, it was believed that the levels of lead and copper were back within a safe range.
    - Residents in Zone 1, Zone 2, and Zone 3 should flush all hot and cold water taps for 30 minutes.
    - Information was shared about short- and long-term effects of fluoride consumption.
- **5:32 PM** – Utah Department of Environmental Quality (DEQ) posted on their Twitter Feed:
    - "BREAKING: High levels of lead and fluoride are present in Sandy City municipal drinking water in the aftermath of last week's storm. Efforts are being taken to mitigate the situation."
- **9:32 PM** – A reverse 911 call was put out to Zone 1, Zone 2, and Zone 3 stating:
    - Sandy's City's water system is safe.
    - However, if you live between 700 East and 2200 East (Highland Drive) and 10600 South to 11400 South and have not flushed your water system since February 7, please do so now.
    - Recently received laboratory results from last week's samples show that elevated levels of lead and copper were also present during the fluoride incident on February 7.
    - To flush your water system, start with running all hot-water taps for 30 minutes, then run all cold-water taps for 30 minutes.
    - For more information please go to the SCPU website.

Saturday, February 16, 2019

- In the morning, due to a lack of data confirming lead and copper results had returned to normal, the DEQ and the Governor's Office required the City to issue a "Do Not Drink Order" for Zone 1, Zone 2, and Zone 3.
- **Approximately 8:30 AM** – City certified water system operators were dispatched with 28 sample bottles to collect representative samples for all metals testing from Zone 1, Zone 2, and Zone 3, as well as all the schools located in each zone.
- An Emergency Operations Center was initiated and was in operation by late morning. Water distribution stations were set up around the affected area. A training was developed for City employees and volunteers on how to take water samples.
- City employees were trained on how to take samples and were sent to various neighborhoods. A total of 192 samples were collected on February 16 and sent to Chemtech-Ford for testing.
- **2:02 PM** – The City's Operations Manager requested a same day rush for a full metals suite for the samples collected on February 7.

- **2:30 PM** – The City's Water System Supervisor and Compliance Officer received the investigative certified laboratory results from Metro showing fluoride levels of up to 152 mg/L in samples taken on February 7. These results were forwarded to the City's Chief Engineer, who had been assigned to ensure all required information was delivered to DDW. Miscommunication led to a delay in delivering these results to DDW until February 23.
- **2:53 PM** – The City emailed DDW and SLCoHD the lead and copper results from the two February 15 follow-up samples taken at the same homes where the pre-flushing samples were taken on February 7. Lead results were non-detect and 0.0214 mg/L. Copper results were 0.0766 mg/L and 0.381 mg/L.
- **7:23 PM** – The City emailed DDW the full metals suite analysis performed on the two investigative metals samples collected on February 7. These results indicated high levels of arsenic, aluminum, iron, and manganese in addition to the previously known high lead and copper levels. The City was notified to update the public notice to include the health effects for these additional metals. DDW assisted in the public notice updates.

Sunday, February 17, 2019

- A meeting between the EPA, DEQ, SLCoHD, and the City (participants unknown) was held. In this meeting, a decision to lift the "Do Not Drink Order" for Zone 3 was made after 28 samples were returned with levels below the action limit. All parties agreed to wait for additional results before removing the "Do Not Drink Order" from Zone 1 and Zone 2.
- **11:37 AM** – A reverse 911 call was sent out notifying residents of Zone 3 that the "Do Not Drink Order" had been lifted.
- **Approximately 7:00 PM** – DDW allowed the City to lift the "Do Not Drink Order" from Zone 1 and Zone 2 with a total of 132 additional samples.

Monday, February 18, 2019

- The City provided DDW with additional laboratory results and a reverse 911 report.
- **7:00 PM** – The City held a town hall meeting at 7:00 PM, where residents voiced their concerns about the response process and public notification. The PowerPoint presentation delivered during this meeting has been included in Appendix I.

Tuesday, February 19, 2019 to Present

Since February 18, 2019, the City has continued ongoing monitoring and customer support through the present day. Below is a summary of the actions taken:

- On February 19, 2019, City staff reviewed the AMI data to determine which houses in Zone 1 had not flushed their plumbing. The next day, water system operators visited the homes identified and assisted homeowners in flushing their plumbing systems.
- 2,106 properties where tested for lead and copper within Zones 1, 2, and 3 (Figure 3-1). All sample results have been provided in Appendix F.
- Based upon initial tests, 7 properties tested above the Action Levels for lead and copper.
- Follow-up confirmation testing was performed where initial testing results exceeded action levels. Residents were notified of all exceedances.

- The City worked with homeowners and completed mitigation efforts in homes where lead and copper levels continued to exceed allowable levels. Mitigation efforts included replacing pipelines in two homes and replacing kitchen/bathroom faucets in three homes. Invoices for each of the replacements have been included in Appendix J.
- Follow-up tests were completed to confirm the effectiveness of the mitigation work.
- All properties that tested above the Action Level have been mitigated and retested with results below the Action Level for both lead and copper.

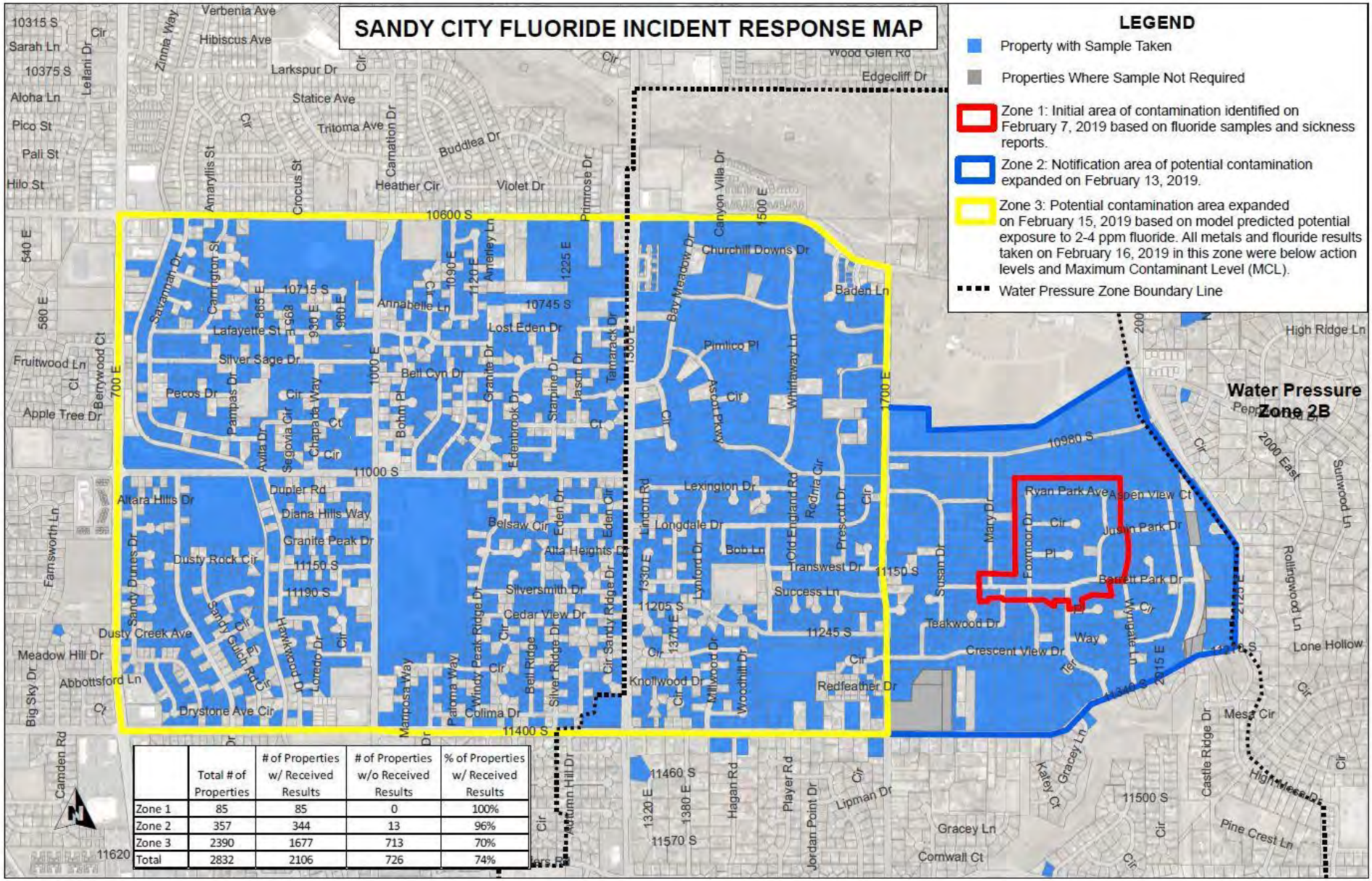


Figure 3-1: Properties sampled in response to the event

CHAPTER 4 – FLUORIDE MODELING ANALYSIS

An extended-period hydraulic model was used throughout the response process and into the investigation process to understand the extent and concentrations of fluoride throughout the City's distribution system, hereafter referred to as the "fluoride model." This section describes the different phases of the model, the calibration, and the results.

MODEL BACKGROUND

Much of the content for this section comes from the EPANET 2.0 User Manual by Lewis Rossman. EPANET was the primary software used to estimate the movement and concentration of fluoride through the distribution system during the event. EPANET is a computer program that performs extended-period simulation (EPS) of hydraulic and water quality behavior within pressurized pipeline networks. A network consists of pipelines, nodes (pipeline junctions), pumps, valves, storage tanks, and water sources (reservoirs). EPANET tracks the flow of water in each pipeline, the pressure at each node, the height of water in each tank, and the concentration of a chemical species throughout the network during a simulation period comprised of multiple time steps. In addition to chemical species, water age and source tracing can also be simulated.

EPANET is designed to be a research tool for improving the understanding of the movement and fate of drinking water constituents within a distribution network. EPANET provides an integrated environment for editing network input data, running hydraulic and water quality simulations, and viewing the results in a variety of formats. These include color-coded network maps, data tables, time series graphs, and contour plots which are presented in this report to present the results of the fluoride modeling analysis.

Hydraulic Modeling Capabilities

Full-featured and accurate hydraulic modeling is a prerequisite for effective water quality modeling. EPANET contains a hydraulic analysis engine that can accurately simulate the function and operation of a distribution system and accurately predict changing flow and pressure results under a multitude of operating conditions. The method used in EPANET to solve the flow continuity and head loss equations that characterize the hydraulic state of the pipeline network at a given point in time can be termed a hybrid node-loop approach.

The most documented limitation of the hydraulic modeling capabilities of EPANET is the pressure-driven analysis (PDA) that assumes all demand is satisfied. Inaccurate negative pressure results are calculated if demands exceed supply. As long as supply meets the demands in the simulation, this is not an issue. The Sandy City fluoride model does not have any negative pressure results or supply conditions where this would be an issue.

Water Quality Modeling Capabilities

In addition to hydraulics, EPANET models the movement of a non-reactive tracer material through the network over time, models the age of water throughout a network, and tracks the percent of flow from a given node reaching all other nodes over time. EPANET can also model the movement and fate of a reactive material as it grows with time to a limiting concentration like a disinfection byproduct or decays with time like chlorine residual. This EPANET capability is not used in the Sandy City fluoride model because fluoride is a nonreactive constituent that neither grows nor decays as it disperses in the distribution system.

EPANET's water quality solver is based on the principles of conservation of mass coupled with reaction kinetics. A dissolved substance will travel down the length of a pipeline with the same average velocity as the carrier fluid. Longitudinal dispersion is not an important transport mechanism under most operating conditions. This means there is no intermixing of mass between adjacent parcels of water traveling down a pipeline. At junctions receiving inflow from two or more pipelines, the mixing of fluid is taken to be complete and instantaneous. Thus, the concentration of a substance in water leaving the junction is simply the flow-weighted sum of the concentrations from the inflowing pipelines. Water in storage facilities (tanks and reservoirs) is completely mixed where the concentration throughout the tank is a blend of the current contents and that of any entering water. In the Sandy fluoride model, no elevated fluoride concentrations reach the tanks.

EPANET's water quality simulator uses a Lagrangian time-based approach to track the fate of discrete parcels of water as they move along pipelines and mix together at junctions between fixed-length time steps. These water quality time steps are typically much shorter than the hydraulic time step to accommodate the short times of travel that can occur within pipelines. Initially each pipeline in the network consists of a single "segment" whose quality equals the initial quality assigned to the upstream node. As time progresses, the length of the most upstream segment in a pipeline increases as water enters the pipeline while an equal loss in length of the most downstream segment occurs as water leaves the pipeline. The size of the segments in between these remains unchanged (See Figure 4-1).

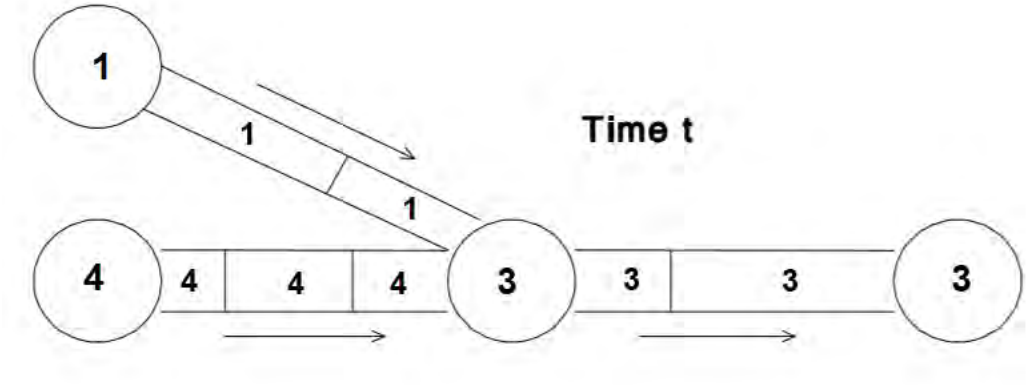


Figure 4-1: Calculation of fluoride concentration in EPANET

At the end of each such time step, the water from the leading segments of pipelines with flow into each junction is blended together to compute a new water quality value at the junction. The volume contributed from each segment equals the product of its pipeline's flow rate and the time step duration. If this volume exceeds that of the segment then the segment is destroyed and the next one in line behind it begins to contribute its volume. New segments are created in pipelines with flow out of each junction, reservoir, and tank. The segment volume equals the product of the pipeline flow and the time step. The segment's water quality equals the new quality value computed for the node. This process is then repeated for the next water quality time step.

The most documented limitation of the water quality modeling capabilities of EPANET is overly long timesteps can yield errors in the concentration estimate. A timestep sensitivity analysis was performed in the Sandy fluoride model to ensure the timesteps used were sufficiently short to prevent calculation inconsistencies. A hydraulic timestep of 15 minutes was used with a water quality timestep of 5 minutes.

SANDY CITY MODELING

A steady-state hydraulic model was prepared for the 2010 Sandy City Water Master Plan by Bowen Collins & Associates. This model included all the pipelines in the distribution system and was calibrated for existing demand conditions. In 2012, HAL converted the model to an EPS by adding control settings using information from the City's SCADA system and from City personnel. The model was calibrated using available SCADA data at the time. In the summer of 2018, the model City personnel had been maintaining since 2012 was updated by HAL using current billing data, source data, and system control information to more accurately represent the City's current conditions.

In response to the fluoridation overfeed incident, the first hydraulic modeling efforts were made by City personnel. After the fluoride dosing pump operation was discovered on February 7, SCPU Engineering Division updated a previously prepared winter scenario hydraulic model to trace the movement of water originating from a location near the Paradise Valley Well facility to understand the movement of water in the area. This simulation provided information on the possible movement of fluoride in the distribution system. It did not include any information related to the concentrations of fluoride. Figure 4-2 shows the initial results. The red dots in Figure 4-2 represent locations receiving more than 40 percent of the water from the location near Paradise Valley Well facility. Because this tracing model represents the general pattern of water movement in this area, the results are consistent with calibrated models developed later to understand the fluoride overfeed incident.

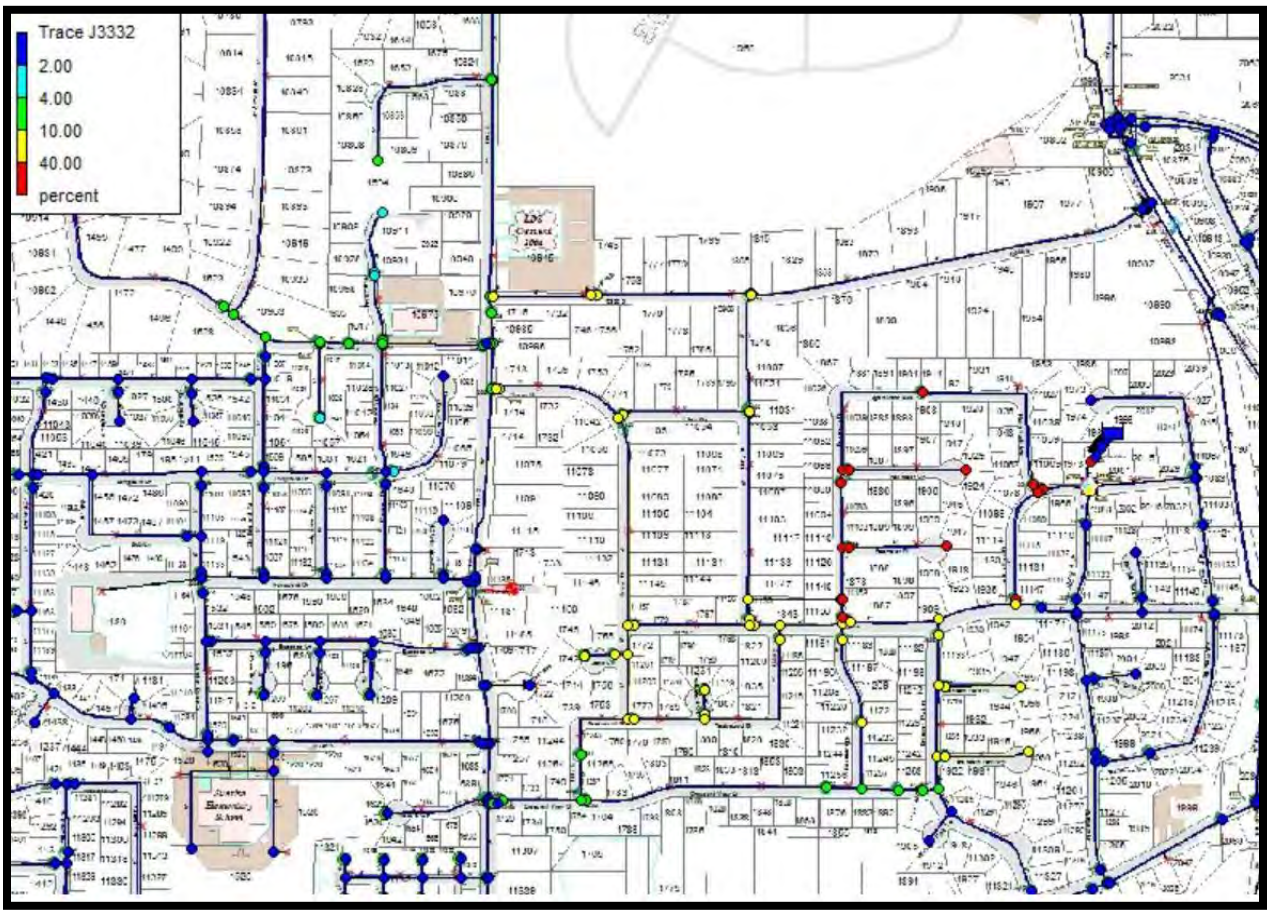


Figure 4-2: Sandy City hydraulic modeling trace results.

On February 7, 2019, City personnel made changes to the previously prepared winter model to increase accuracy. Demands were updated to average daily demand in January/February, every well in the model was turned off, and the Metro connection flows were adjusted to match the characteristics during the event. The legend was adjusted to change the color scale of each percentage.

HAL MODELING

The City called HAL on February 8, 2019, to prepare a forensic hydraulic model to understand the extent of elevated concentrations of fluoride in the distribution system. Using information provided by City staff, HAL began developing an extended-period model running for 96 hours, starting at 12:00 AM February 5, 2019, and ending at 12:00 AM February 9, 2019. Systemwide adjustments were made in the model to match the conditions of the distribution system during the time of the event. Model inputs included:

- Pump station control settings
- PRV settings
- Tank levels
- SCADA-controlled valve settings

- Daily demand time pattern
- Flushing patterns
- Fluoride injection timing and rate

These are described in detail below.

DATA SOURCES AND MODEL INPUT DETAILS

The hydraulic model inputs were collected from a variety of sources including field inspections by water system operators and SCADA records. All distribution system information sent to HAL by the City to prepare the model is included in Appendix A.

Pump Station Control Settings

Pump station controls that turn the pumps on and off were determined using exported SCADA records and previous model controls. Controls were updated as necessary during the calibration of the model.

PRV Settings

PRV settings were collected by water system operators in the weeks after the event. Each PRV setting was checked multiple times to ensure the correct setting was recorded.

Tank Levels

Tank levels were exported from the SCADA records. Flows into and out of the tanks were calculated using the geometry of each tank to inform the daily demand time pattern

SCADA-Controlled Valve Settings

The City has several control valves that can be opened and closed remotely to move water from one pressure zone to another. SCADA-controlled valve settings were exported from the SCADA records.

Daily Demand Time Pattern

The daily demand time pattern was determined using exported SCADA records. The sum of the water coming in plus the water leaving the tanks was equal to the usage at any given period of time.

Flushing Patterns

Flushing patterns were created in the model to define the timing and flow of the flushing. Flushing patterns were determined using field observations from water system operators and flow and pressure values from the SCADA export.

Fluoride Injection Timing and Rate

Fluoride injection timing and rate were determined using exported SCADA records of the Paradise Valley Well's fluoride day tank scale weight.

ANALYZING CUSTOMER WATER USE

As part of its Advanced Metering Infrastructure (AMI) the City has installed water meters that keep hourly records of customer water usage. To understand what concentrations of fluoride may have been pulled into each house, Figures 4-3 through 4-5 compare modeled fluoride concentrations and customer water usage during the time of the event for three locations where customer complaints were filed. The spikes in water use at the meter represented by the blue lines are when the homeowner flushed their premise piping. Sandy City used this meter data to ensure all homes with potentially elevated levels of the fluoride solution were flushed. Appendix C includes figures for every location where a customer complaint was filed.

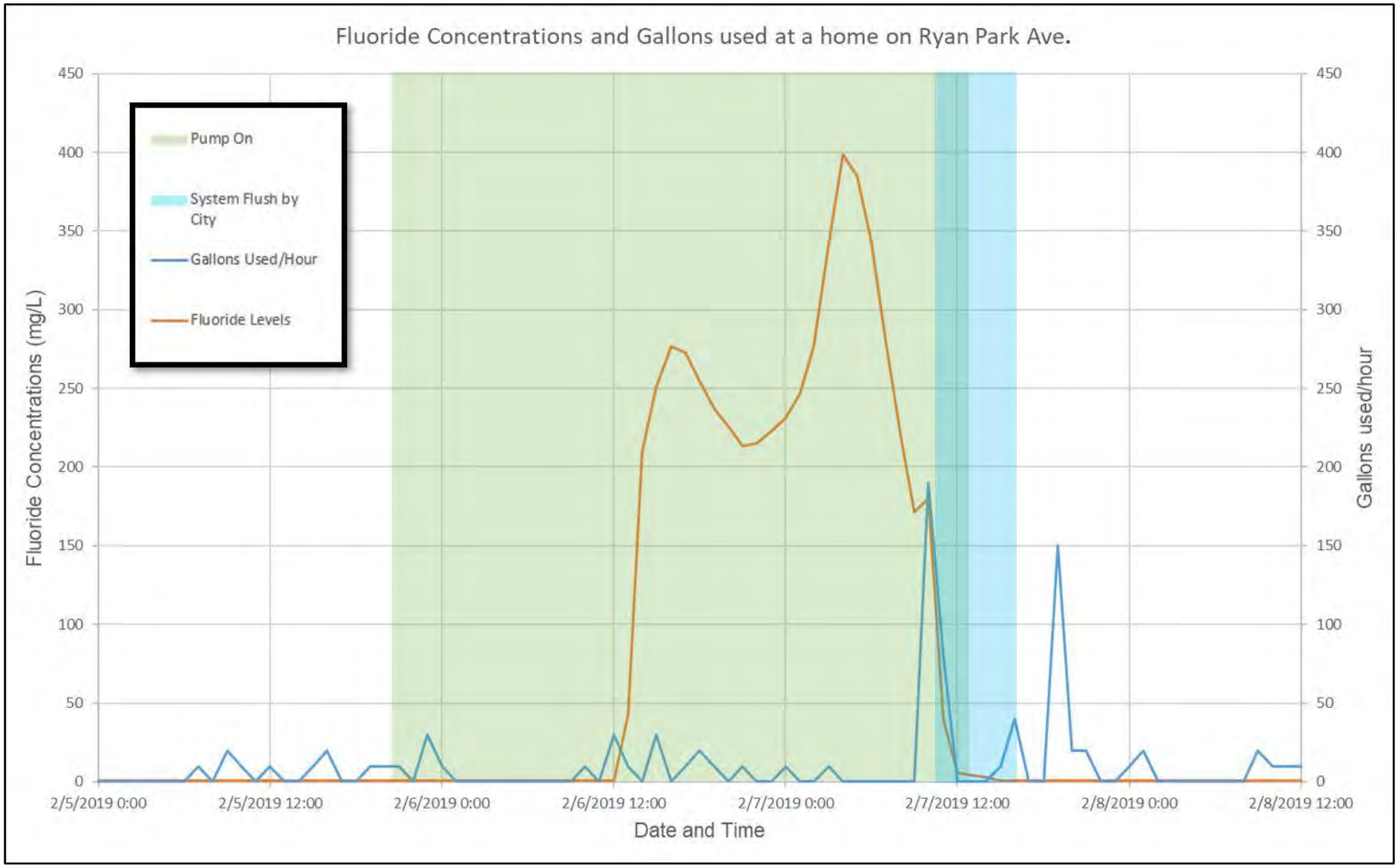


Figure 4-3: Simulated fluoride concentrations and metered water use at a home on Ryan Park Ave. during event.

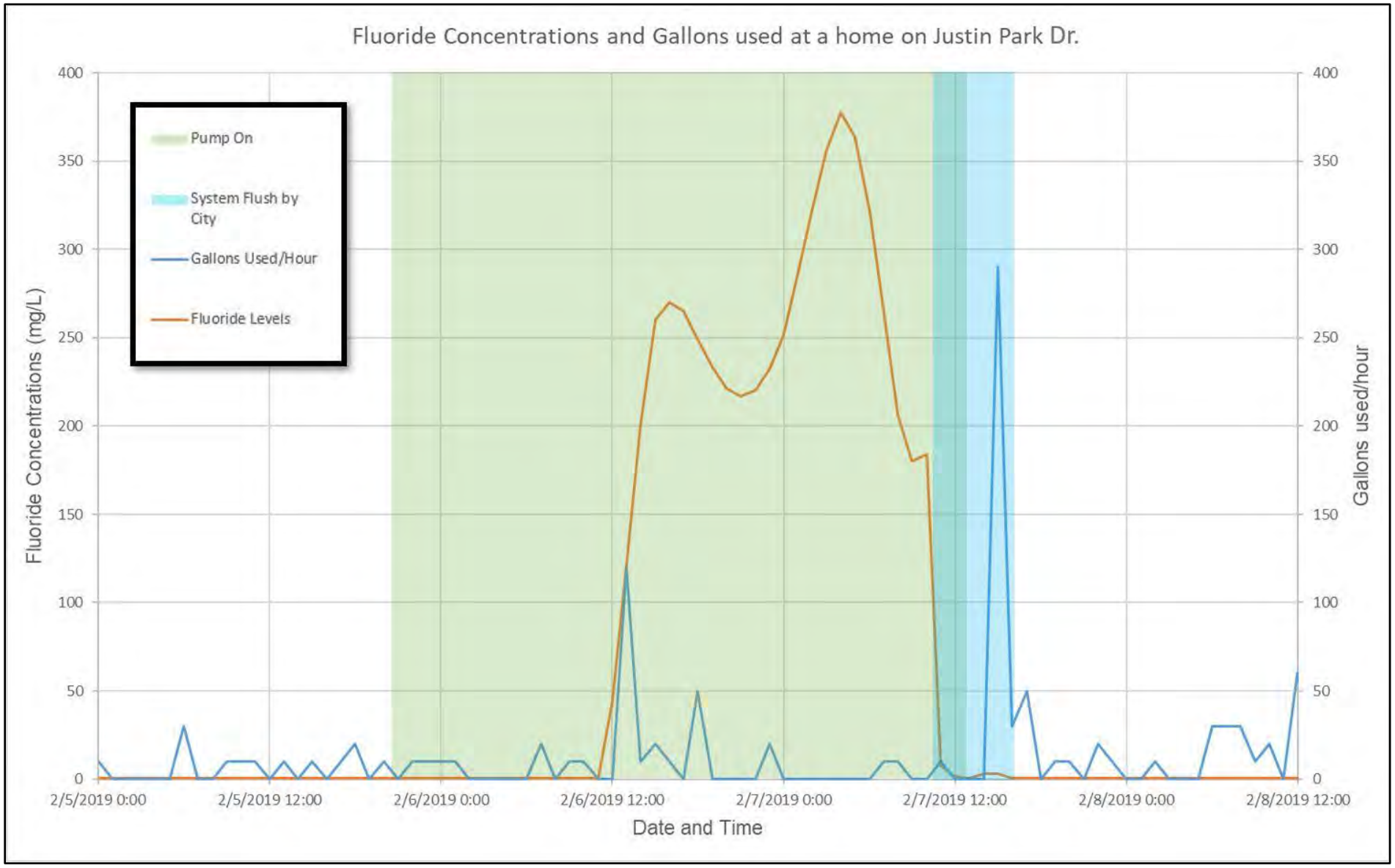


Figure 4-4: Simulated fluoride concentrations and metered water use at a home on Justin Park Dr. during event.

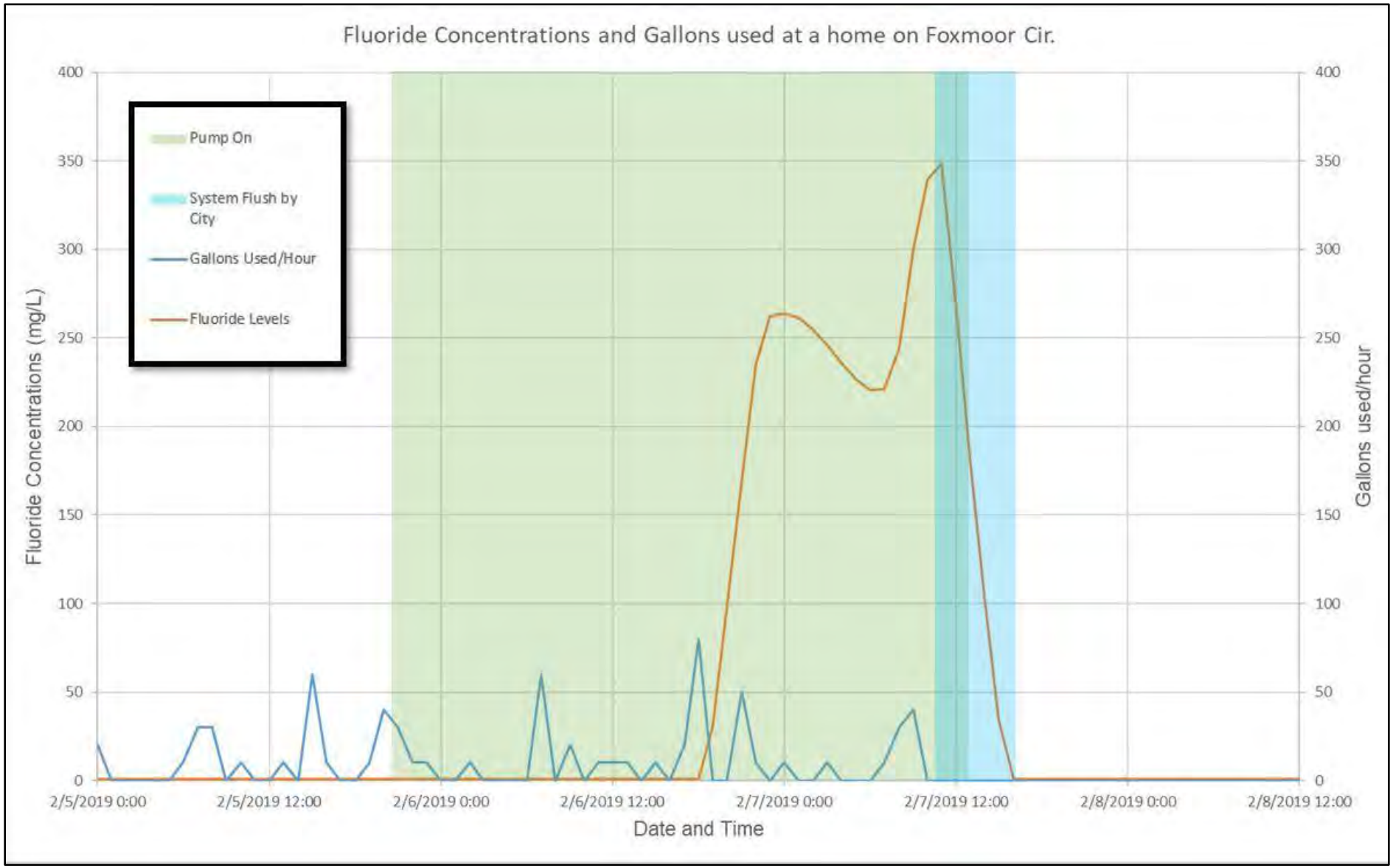


Figure 4-5: Simulated fluoride concentrations and metered water use at a home on Foxmoor Cir. during event.

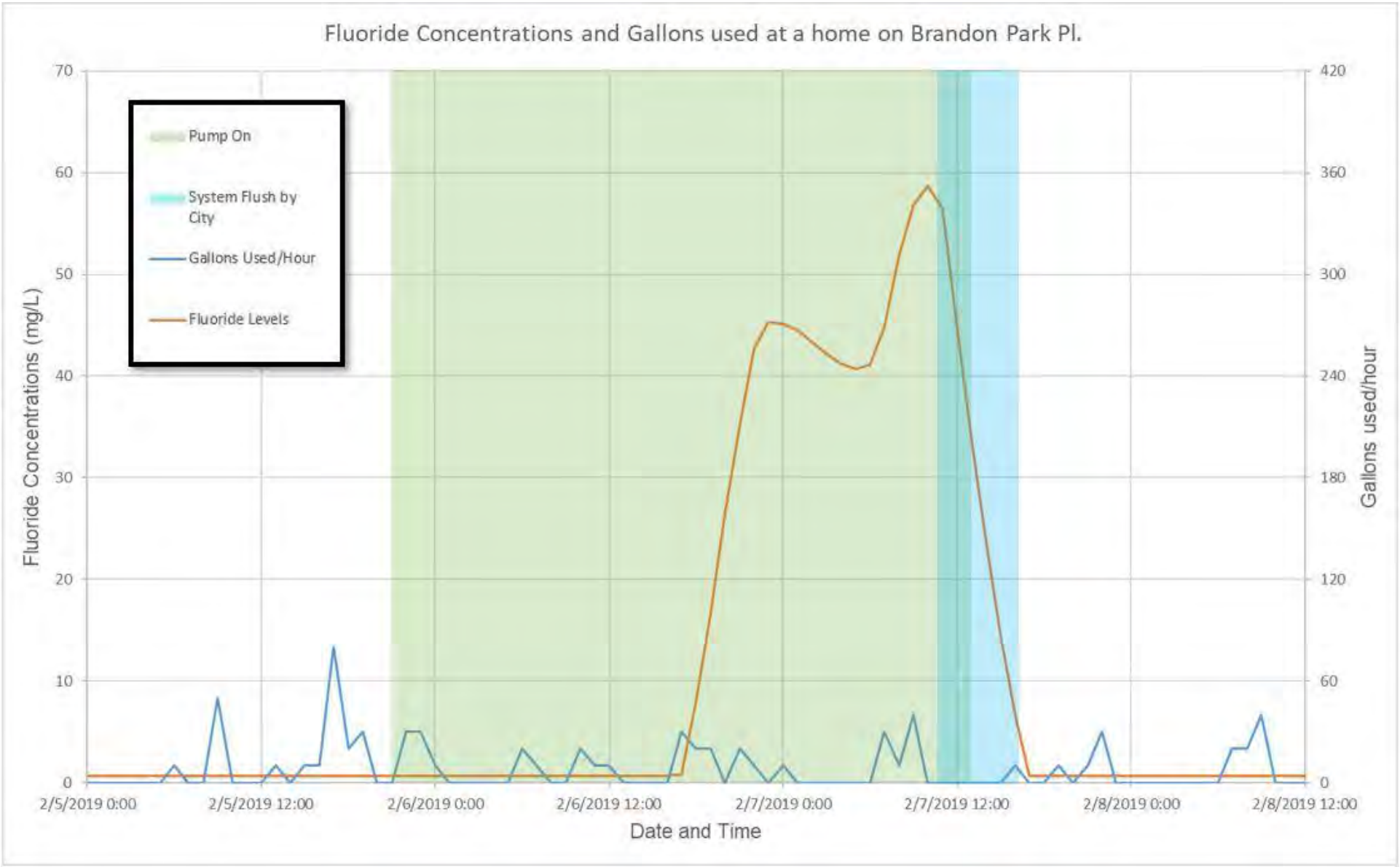


Figure 4-6: Simulated fluoride concentrations and metered water use at a home on Brandon Park Pl. during event.

MODEL CALIBRATION

Throughout the hydraulic modeling process, the model was calibrated to match the available SCADA data and empirical data. Calibration is a comparison of the computer results, field tests, and actual distribution system performance as recorded by the SCADA system. When the computer model does not match the SCADA information and available field tests within a reasonably acceptable level of accuracy, the computer model is adjusted to match field conditions, or field investigations are performed to ensure facility conditions are accurately simulated.

The City's hydraulic model was calibrated using all available information. Table 4-1 and Figure 4-6 are two examples of how the model was calibrated to the customer complaint reports and the PRV settings.

Table 4-1: PRV Calibration

Location	System Downstream Pressure (psi)	Model Downstream Pressure (psi)	System Upstream Pressure (psi)	Model Upstream Pressure (psi)
1263 E. 10600 S.	CLOSED	CLOSED	CLOSED	CLOSED
1265 E. 11000 S.	66	65	112	112–115
1287 E. Alta Heights Dr.	62	63	112	109–113
1226 E. 11400 S	CLOSED	CLOSED	CLOSED	CLOSED
1203 E. Cherry Knoll	74	75	122	121–124
1213 E. Sanders Rd.	70	71	119	117–120
1283 E. Hidden Valley Rd.	60	60	NA	105–109
1298 Spring Ridge Rd.	83	83	128	128–132
10980 S. 2000 E.	55	54–58	142	136–150
11128 S. 2000 E.	59	56–60	142	138–150
11270 S. 2000 E.	74	70–73	155	150–164

Additional calibration results can be found in Appendix D.

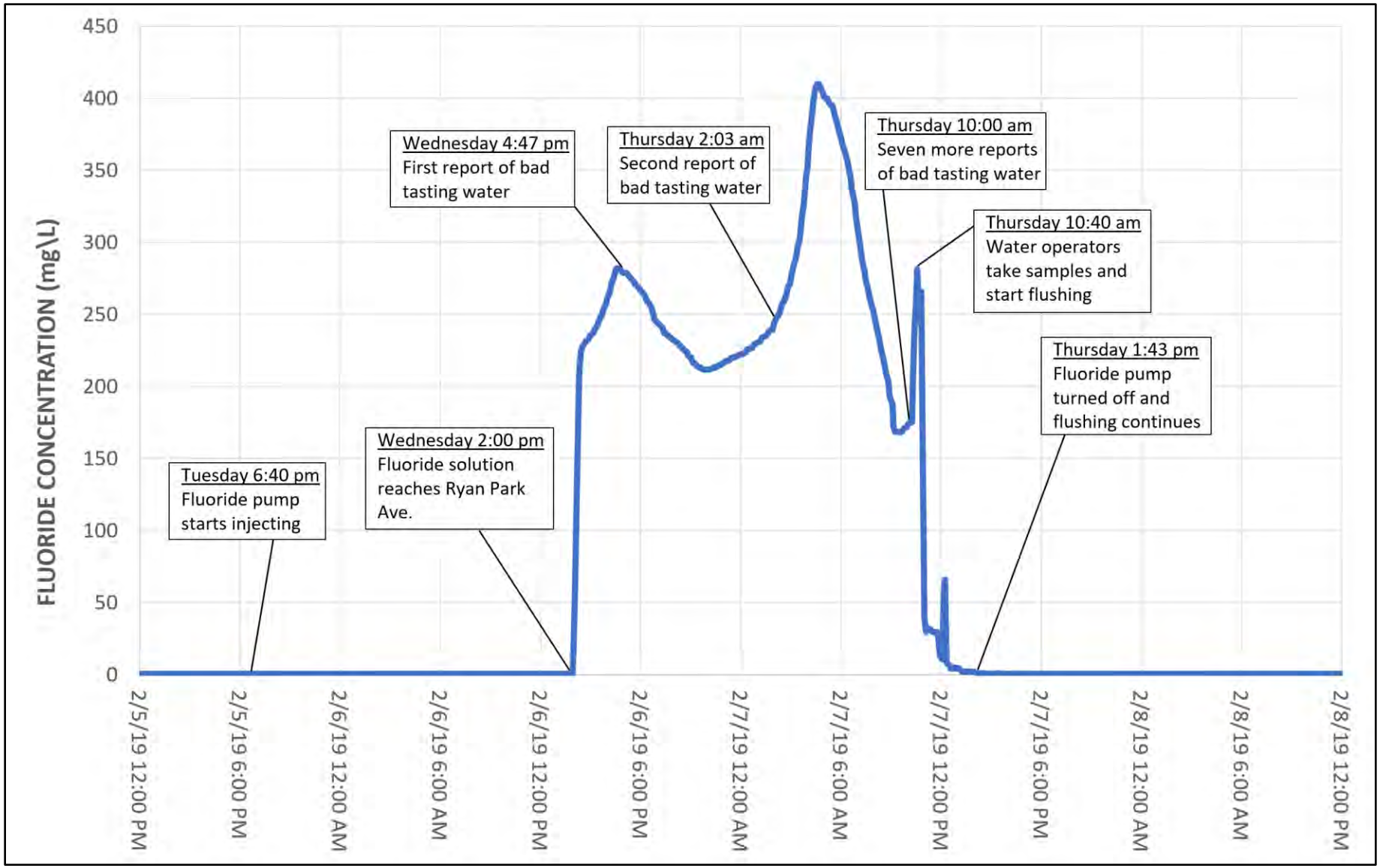


Figure 4-7: Simulated fluoride concentrations on Ryan Park Ave.

SIMULATED FLUORIDE CONCENTRATIONS

The model simulates the higher fluoride concentrations arriving at Ryan Park Avenue just before the first report of bad-tasting water at 4:47 PM on Wednesday, February 6, 2019. The fluoride concentrations decrease as water use picks up in the evening. Then the fluoride concentrations increase in the middle of the night when water use slows. In the morning, multiple reports of bad-tasting water are received as water use picks up again. By 10:00 AM, after which the City took water samples, the simulated fluoride concentrations match the test results of 86 to 152 parts per million (ppm). The model then accurately simulates the results of flushing and the fluoride pump being turned off.

The maximum fluoride concentrations simulated by the model during the fluoride overfeed event are represented in Figure 4-7 by area. The model indicates that it took 16.5 hours (6 PM February 5, 2019, to 10:30 AM February 6, 2019) for the fluoride to travel 100 feet in the 12-inch diameter discharge pipeline from the well to the 8-inch diameter water main in Justin Park Drive.

The model simulates that elevated fluoride concentrations above 4 ppm did not cross 1700 East due to the predicted volume and flow of the water in the 16-inch diameter pipeline in 1700 East.

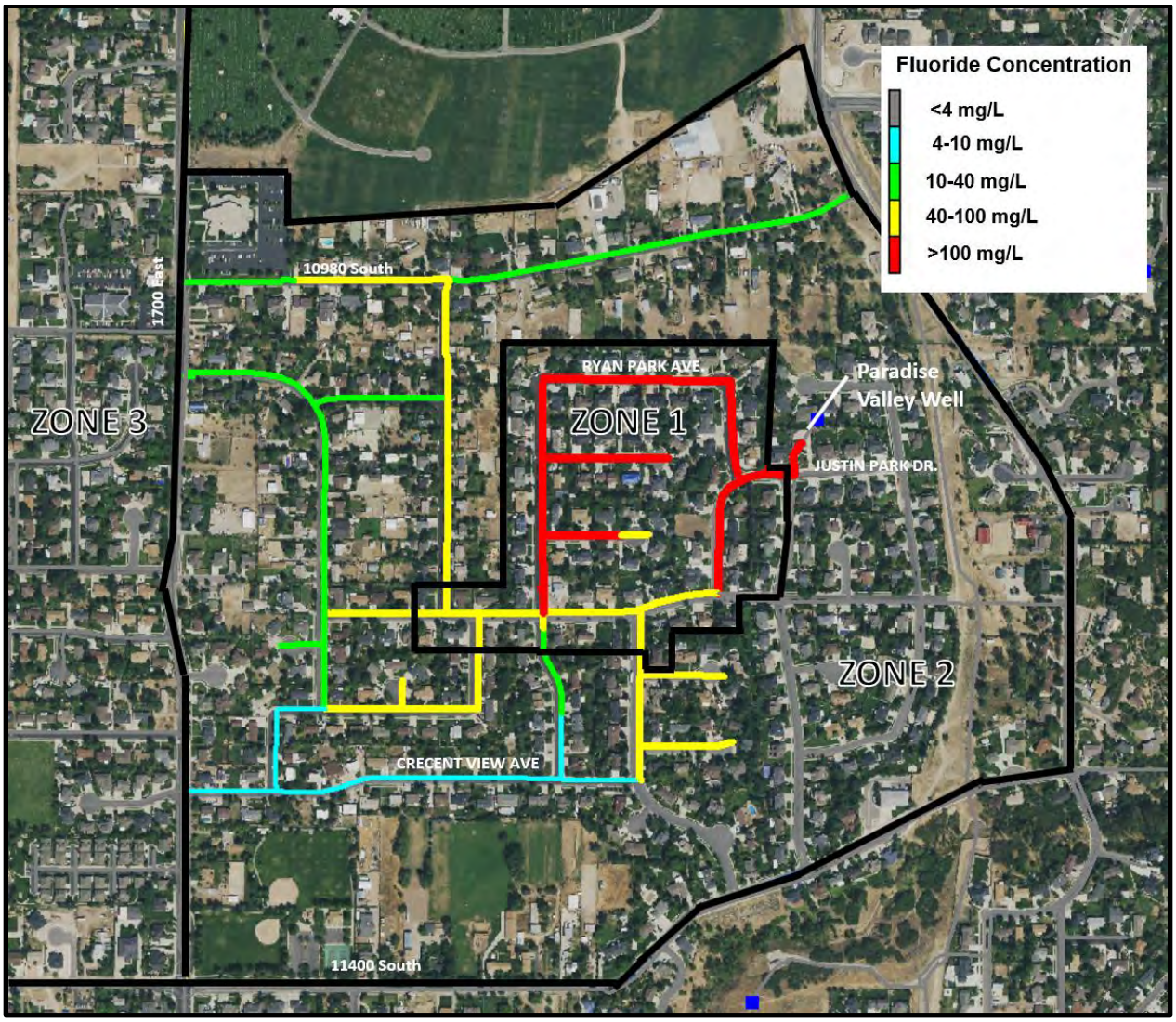


Figure 4-8: Simulated maximum fluoride concentrations during fluoride overfeed event.

CHAPTER 5 – ASSESSMENT

The following section is an assessment of the actions taken in response to the fluoride overfeed. This assessment has been developed through interviews with the following involved entities:

- Sandy City
- Utah Division of Drinking Water
- Salt Lake County Health Department
- Metropolitan Water District of Salt Lake & Sandy
- Chemtech-Ford Laboratories

Many of the comments from the interviews described positive actions taken before and after the fluoride incident. These positive actions are summarized below. Also described below are items and actions that were identified as needing improvement.

POSITIVE ACTIONS

Flushing

The initial response by the City's water system operators was prompt. After the first set of samples was taken, operators began flushing hydrants in the affected area. Weather conditions made it difficult to access the hydrants, and in some cases required operators to use snowplows and backhoes to control the water. Once the fluoride dosing pump was discovered to be on, water system operators backflushed the well, which prevented additional fluoride from entering the distribution system. Hydraulic modeling results show that the flushing effectively purged the high fluoride concentrations from the distribution system by 8:00 PM on the evening of February 7, 2019.

AMI Review

The City provided a public notice to the affected residents to flush their hot and cold water taps. After the notice, the City looked at its Advanced Metering Infrastructure (AMI) data to make sure every resident in the affected area had flushed. Houses that had not flushed were visited by water system operators, who offered to assist the resident in the flushing process.

Sample Results

To create transparency between the City and its residents, the City requested that Chemtech-Ford create a webpage showing all sample results from the incident. The webpage was updated with new results when they were available.

Chemtech-Ford had also set up an automatic system to send water quality test results directly to DDW before this event took place. This saved valuable time in assessing test results quickly.

NEEDING IMPROVEMENT

Documentation

Throughout the response process, lack of documentation caused problems for each agency involved. For example, Sandy City water system operators did not document the houses that had received the first public notification on February 7, which may have led to confusion when Sandy was asked to expand the size of the notification area. Also, DDW could have clarified in writing the requests made during the conference calls with the City. The City could have recorded these conference calls to ensure they completed each request. Documentation is very important during an incident like this, and should be made a top priority.

Sampling

Too few samples were taken in the early stages of the event. DDW was expecting test results for fluoride and metals to be reported earlier. They did not feel that the City provided adequate documentation of the extent of the overfeed or the concentrations of contaminants in the drinking water. This led to a “Do Not Drink Order” ten days after the fluoride dosing pump was shut off.

Field sampling could have helped quickly identify the important tracer perimeter (in this case pH) and field-testing equipment could have been used to document and verify the extent of the contamination and ensure all homes had been flushed the first day.

On February 16, during the “Do Not Drink Order”, the City committed to taking 3,000 samples throughout the City. DDW and SLCoHD now believe this large amount of sampling may have taken away from the quality of the samples and the sampling technique. A strategic sampling plan would have been more effective and should be utilized in the future.

Public Notification

DDW and SLCoHD both have requirements in relation to public notification. Coordination between DDW and SLCoHD about the public notification process delayed delivering the document to affected residents.

Sandy City removed required items from a public notification that were not noticed by in a review by DDW at the time, but were discovered later after the notices had already been distributed.

Communication Methods

Various forms of communication were used throughout the response process, including text messages, phone calls, meetings, and emails. There were a few instances where information provided in emails or text messages was not delivered to all of the necessary parties in a timely manner. This created differing levels of understanding and lead to confusion between the involved groups.

Laboratories

The process of submitting the City samples for testing through Metro, rather than directly to Chemtech-Ford, delayed the analysis and results. Metro laboratory employees were not immediately available to conduct the requested tests and the results were not immediately communicated to the City once complete and received by Metro.

Communication to the Public

The City should have proactively used social media and enlisted the news media to inform the affected residents, rather than the social media and news media steering the conversation afterwards.

Building public trust cannot wait until a negative event occurs. The public should regularly hear of the positive things drinking water professionals are doing every day to supply clean water and protect public health. Notifications of negative impacts are required, but notifications of positive actions can be just as effective before, during, and after.

CHAPTER 6 – RECOMMENDATIONS

This section describes recommendations for future actions developed through interviews with the involved parties.

GENERAL

- Written notes should be collected during every conference call and meeting. They should be sent to all involved parties to ensure a common understanding of the issues, deliverables, expectations, assignments and time frame. A designated person should compile the notes and distribute them by email to the other attendees.
- Consumer confidence reports for Sandy's water system should be made easily accessible. These reports can help agencies quickly determine background water quality.
- The City should work with Metro to develop an understanding of what water quality testing needs to go directly to a designated laboratory like Chemtech-Ford for specialized testing, and specify these in the Emergency Response Plan.
- Water system personnel should be educated on the potential of hydrofluorosilicic acid on human health, water system infrastructure, and premise plumbing.
- The City should provide maps and simple step-by-step procedures for residents to follow in an emergency response event.
- The City should utilize their field instruments to help understand the extent of a contaminant both in the distribution network and at customers taps in addition to taking official water quality samples.
- The City should develop a system to ensure that text messages and emails are delivered to all necessary recipients in a timely manner.
- The City's emergency response procedures should be updated to include extensive investigative water sampling to confirm water model predictions during an event.

OPERATIONAL

- Operators should take two copies of the public notice with them to develop a list of residents contacted during door-to-door notifications. One copy should be provided to the resident, and the other should be signed by the resident and kept as record of the notification and the address of the notified resident.
- The City should develop the in-house knowledge and ability to review programming and maintain the SCADA system.
- SCADA maintenance work completed by outside contractors should be inspected by capable City personnel or a third party to ensure all work is completed correctly. Currently the City does not have the in-house ability to fully inspect and verify PLC logic of the SCADA system.
- The City should update its PLC/SCADA work procedures to document changes, functionality, and/or testing and completion logs.

- Logic (programming) in all PLCs at all facilities should be checked to ensure that there are no hidden alerts and that all the logic is correct. Any active alerts that are giving false alarms because of faulty relay switches or sensors should be addressed.
- Mechanical switches at all facilities should be checked to ensure that each one is working correctly.
- Valves should be kept open when flushing to ensure contaminated water is purged from the distribution system in the least amount of time. Shutting valves has the potential of isolating the contaminate.
- Flushing and testing should focus on dead-end pipelines. Dead-end pipelines without fire hydrants should be flushed and tested at customer taps.
- Water operators should be immediately contacted whenever the Fire Department is dispatched to a water complaint.

FLUORIDATION SYSTEM

- A condition hard-wiring the fluoride dosing pump to the well flow should be created.
- pH and fluoride monitors should be installed at well sites, downstream of the fluoride pump, to notify the on-call water operator if the pH reading is outside the allowable limits.
- A mechanical “HAND” setting switch with a timer for the fluoride dosing pump should be installed to shut off the pump after an allotted amount of time.
- The “HAND” setting should be removed from the SCADA system to avoid an accidental remote start.
- A SCADA alarm should be developed to provide an alert when the fluoride dosing pump is activated.
- The City should remove the “clear all” command and add the ability to clear specific alarms.
- The City should consider add a PLC and/or electric contact relay alarm and externally visible (red light) with signage to call Sandy Emergency Dispatch.
- The City should consult fluoridation system experts to determine potential additional safety features for the fluoridation system.

STANDARD OPERATING PROCEDURES

- Every fluoride dosing pump should be unplugged from the electrical current when the well is not in operation.
- Field sampling protocol should be updated to record the date, time, location, and the sampler.
- Operators should carry field sampling forms with them to avoid delays.
- Emergency sampling bottles should be kept on hand to avoid delays.
- Samples should be taken directly to laboratory during an emergency event.
- Valves located on the feed lines from the fluoride day tank to the dosing pump should be closed when a well is not in operation.
- Valves located on the feed lines from the fluoride dosing pumps to the discharge pipelines that lead to the water mains should be closed when a well is not in operation.

- All fluoride feed lines from the fluoride day tank to the distribution line should be drained back into the day tank before putting the well out of service.
- Water system operators should always check the fluoride control and SCADA settings after a power outage, repair, maintenance, or outside contractor's work.
- Water system operators should consider starting the fluoridation system after the well has started when the fluoride dosing pump is in "AUTO" and not have to run the fluoride dosing pump in "HAND."
- The fluoride dosing pump should be set to "OFF" when not in use.
- Water system operators should fill the day tank with only enough hydrofluorosilicic acid for one day.
- Maintenance on the fluoridation system should be performed yearly to ensure correct functions of the fluoride dosing pump.
- If possible, the solution in the day tank should be used down to the low level before the well is shut off for an extended period of time.
- Water system operators should not go more than two days without visiting the well. Operators should use an asset management system to alert them of skipped visits.
- A checklist of SOPs/inspection protocols should be created to ensure the shutdown steps are completed by the designated water operator.

COOPERATION WITH AGENCIES

- The City should work with DDW and SLCoHD to implement any other viable and feasible measures that are proposed by consultants as part of the independent investigations that are pending.

APPENDIX A

Information Documenting Water System Conditions During Fluoride Overfeed

Inorganics Report

UTAH18028
Karen Hoagland
1220 East 9400 South
Sandy Utah 84094 (801)352-4412

CustomerID: UTAH18028

Sample Number: E19020707-002

Collect Date:	07-Feb-19	Receiving Date:	07-Feb-19
Collect Time:	10:40:00 AM	Receiving Temp:	10.3
Collected By:	Karen Hoagland		

Site: 1921 Ryan Park Ave Results Comment:

Param:	Result	Units:	Analysis Date/Time:	Analyst:	Method:	Dilution:	DetectionLimit:
Fluoride	85.9	mg/L	2/12/2019 6:38:00 PM	taber	EPA 300.0	100	10

Sample Number: E19020707-005

Collect Date:	07-Feb-19	Receiving Date:	07-Feb-19
Collect Time:	11:05:00 AM	Receiving Temp:	10.2
Collected By:	Karen Hoagland		

Site: 1898 Ryan Park Ave Results Comment:

Param:	Result	Units:	Analysis Date/Time:	Analyst:	Method:	Dilution:	DetectionLimit:
Fluoride	142.6	mg/L	2/12/2019 7:05:00 PM	taber	EPA 300.0	100	10

Metro Lab
9000 South Danish Rd
Cottowood Heights UT 84093
(801) 942-9654

CustomerID: UTAH18028

Sample Number: E19020707-009

Collect Date:	07-Feb-19	Receiving Date:	07-Feb-19
Collect Time:	11:32:00 AM	Receiving Temp:	10.0
Collected By:	Karen Hoagland		

Site: 1900 E. Hydrant Results Comment:

Param:	Result	Units:	Analysis Date/Time:	Analyst:	Method:	Dilution:	DetectionLimit:
Fluoride	43.2	mg/L	2/12/2019 7:33:00 PM	taber	EPA 300.0	100	10

Sample Number: E19020707-010

Collect Date:	07-Feb-19	Receiving Date:	07-Feb-19
Collect Time:	11:47:00 AM	Receiving Temp:	11.3
Collected By:	Karen Hoagland		

Site: 1900 E. Hydrant Results Comment:

Param:	Result	Units:	Analysis Date/Time:	Analyst:	Method:	Dilution:	DetectionLimit:
Fluoride	151.5	mg/L	2/12/2019 8:00:00 PM	taber	EPA 300.0	100	10

Approved By: Claudia Bauleth

Approved Date: 2/16/2019 12:56:36 PM

Note: All samples collected by laboratory personnel are collected in accordance with the sampling procedures as stated in the QA Manual, Section 24

Do not duplicate report except in full or with permission of laboratory.

Report Printed by: Claudia Bauleth

Claudia Bauleth
Laboratory Manager
Bauleth@mwdsls.org

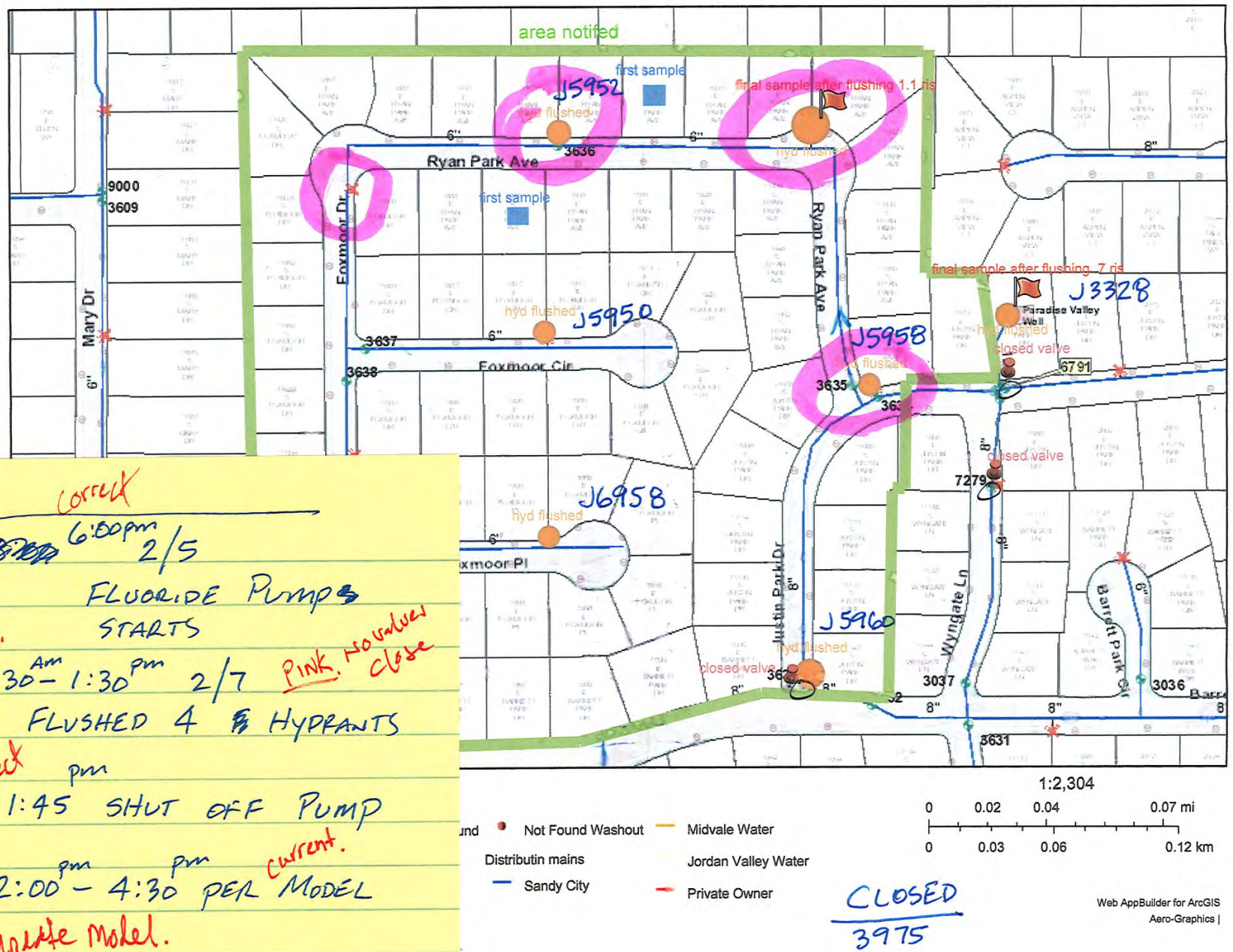
10:30 AM 2/7
1:30 pm

2:00 > PER MODEL
4:30

1:45 > SHUT OFF PUMP

BIGGER MAP

fluoride over feed 2/7/2019



CLOSED
3975

1884 East Fexmoor Pl
801-231-1655 Ted Cowan

correct
6:00pm 2/5
FLUORIDE PUMPS STARTS

Add.
10:30 AM - 1:30 PM 2/7 PINK. No valves Close
FLUSHED 4 HYDRANTS

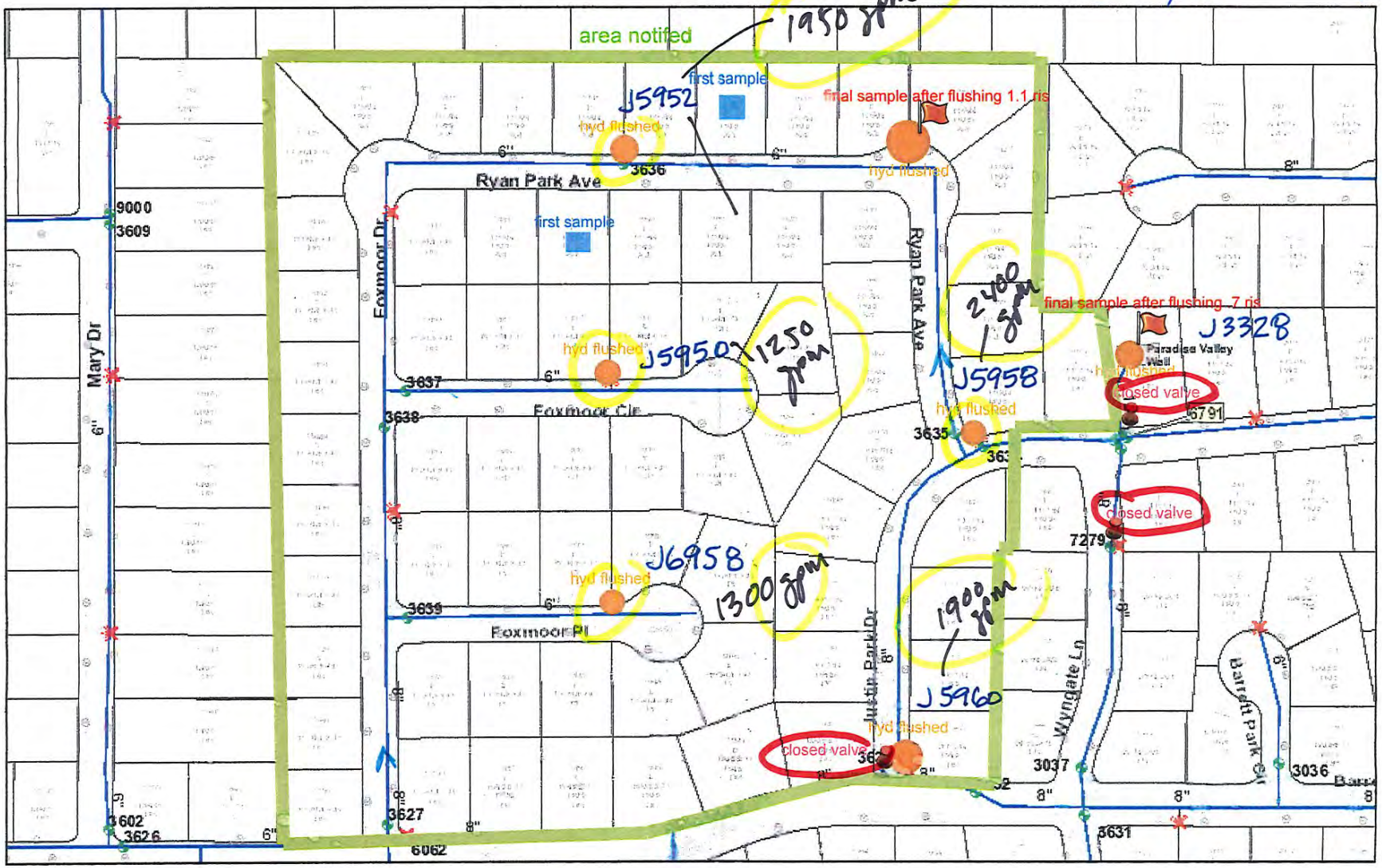
correct
1:45 PM SHUT OFF PUMP

2:00 PM - 4:30 PM PER MODEL current.

Update Model.

BIGGER MAP 183K gal
2:00pm – 4:15pm

fluoride over feed 2/7/2019



1:2,304

0 0.02 0.04 0.07 mi

0 0.03 0.06 0.12 km

2/8/2019, 2:06:03 PM

pubutils.PU.SampleTaps — Hydrant laterals — Valve not found — Not Found Washout — Midvale Water

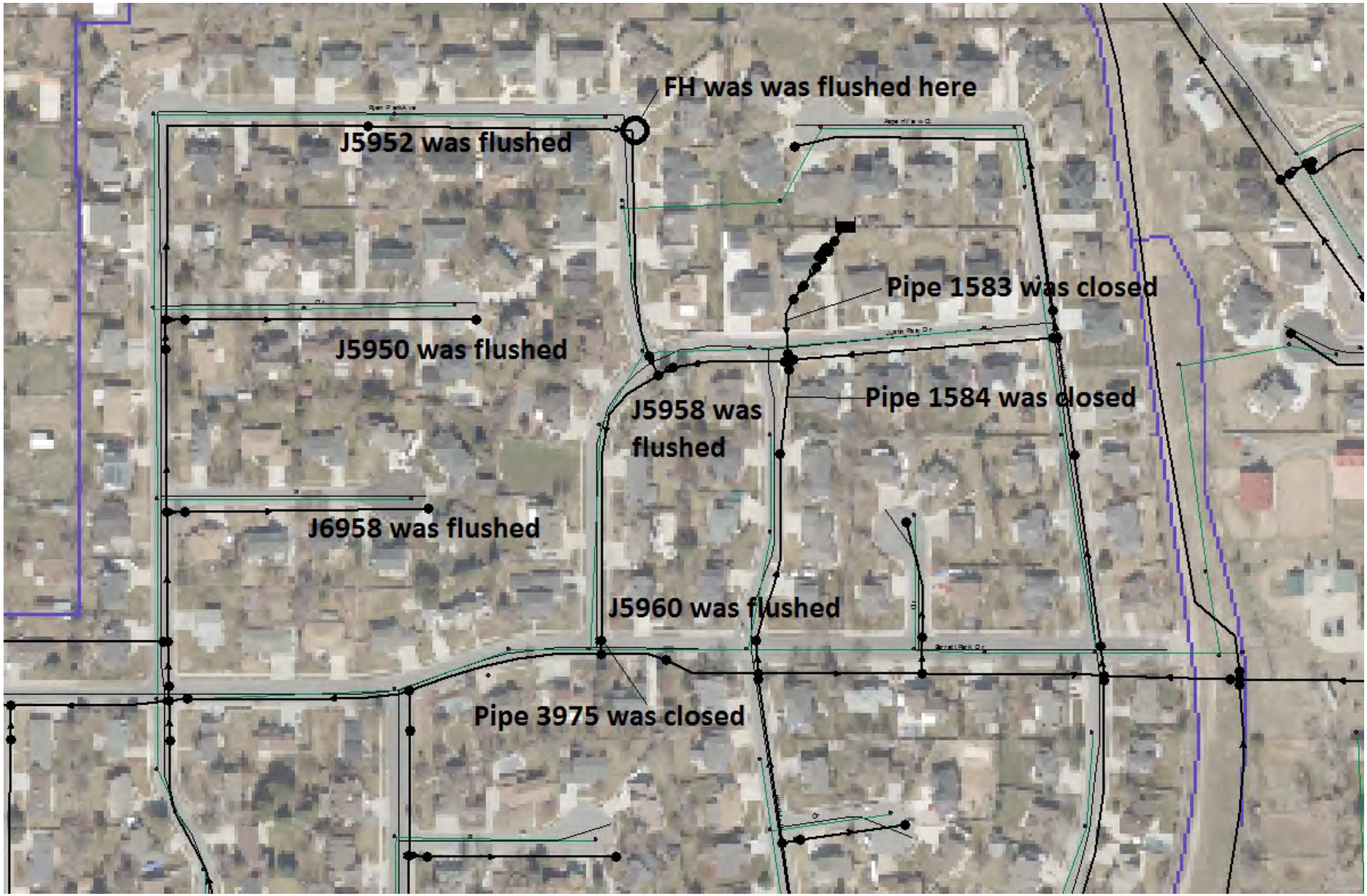
Laterals — Meter Laterals — washout — Distributin mains — Jordan Valley Water

Fire line laterals — Unknown — Washout — Sandy City — Private Owner

CLOSED
3975

Web AppBuilder for ArcGIS
Aero-Graphics |

1889 East Foxmoor Pl
801-231-1655 Ted Cowen


FH was was flushed here
J5952 was flushed
Pipe 1583 was closed
J5950 was flushed
J5958 was flushed
Pipe 1584 was closed
J6958 was flushed
J5960 was flushed
Pipe 3975 was closed

SANDY CITY PUBLIC UTILITIES

THOMAS WARD
PUBLIC UTILITIES DIRECTOR

KURT BRADBURN
MAYOR

MATTHEW HUISH
CHIEF ADMINISTRATIVE OFFICER

March 25, 2019

Utah Division of Drinking Water
195 North 1950 West
Salt Lake City, UT 84116

Re: Issuance of Violations and Administrative Order, Sandy City Drinking Water System #UTAH18028

Dear Division:

The purpose of this letter is to formally provide the information requested in Administrative Order Item No. 13. As part of this response, we are submitting to you, an illness report including data collected by Sandy City, Utah Poison Control and Salt Lake County Health Department and follow-up actions.

The above-referenced documentation is attached hereto and uploaded to the OneDrive file in the "13 – Illness Report".

Sincerely,

Richard Benham, P.E.
Sandy City Public Utilities Engineering Manager

Sandy City: Fluoride Incident Report

Residents Reporting Possible Symptoms Via Calls to Sandy City Staff

#	ADDRESS	SYMPTOMS / NOTES	ACTION
1	If needed, available upon request	Resident: Reported nausea and vomiting, stomach cramps Baby: Reported vomiting on Feb.6&7 Resident's wife: No symptoms	Advised to consult personal physician.
2	If needed, available upon request	Resident reported that she and husband had nausea and vomiting.	Advised to consult personal physician.
3	If needed, available upon request	Resident reported nausea and vomitting.	Advised to consult personal physician.
4	If needed, available upon request	Resident called the Fire Dept. on 2/6/19 and reported a burning feeling in the back of throat when drinking a glass of water before bed, plus reported nausea & stomach cramps.	Advised to consult personal physician.
5	If needed, available upon request	Resident reported vomitting on 2/7 and reported that other member of family was feeling nauseous on 2/7.	Advised to consult personal physician.
6	If needed, available upon request	Resident reported not feeling well.	Advised to consult personal physician.
7	If needed, available upon request	Resident called on 2/7 to report symptoms from 2/6. Resident said that resident and resident's dogs got sick (nausea & vomiting).	Advised to consult personal physician.
8	If needed, available upon request	Reported three people in household with symptoms of diarea and nausea.	Advised to consult personal physician.

(CONFIDENTIAL AND PRIVATE INFORMATION)

Sandy City: Fluoride Incident Report

Residents Reporting Possible Symptons to the Emergency Operation Center Call Center

#	ADDRESS	SYMPTOMS / NOTES	ACTION
1	If needed, available upon request	Resident reported having MS and reported feeling ill, so went to the hospital. Resident reported that the lab results indicated high lead levels in resident's system	Advised to contact Utah Poison Control and/or personal physician
2	If needed, available upon request	Resident reported that resident had been sick.	Advised to contact Utah Poison Control and/or personal physician
3	If needed, available upon request	Resident reported being sick.	Advised to contact Utah Poison Control and/or personal physician
4	If needed, available upon request	Resident reported daugher & husband have both been sick.	Advised to contact Utah Poison Control and/or personal physician
5	If needed, available upon request	Reported wife has been sick.	Advised to contact Utah Poison Control and/or personal physician
6	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
7	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
8	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
9	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
10	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
11	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
12	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
13	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
14	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
15	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
16	If needed, available upon request	Non-specified possible symptoms.	Advised to contact Utah Poison Control and/or personal physician
17	If needed, available upon request	Reported going to doctor.	Advised to contact Utah Poison Control and/or personal physician

(CONFIDENTIAL AND PRIVATE INFORMATION)

Sandy City: Fluoride Incident Report

Residents Reporting Possible Symptoms to Sandy City Staff

#	ADDRESS	SYMPTOMS / NOTES	ACTION
1	If needed, available upon request	Resident: Reported nausea and vomiting, stomach cramps Baby: Reported vomiting on Feb.6&7 Resident's wife: No symptoms	Advised to consult personal physician.
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7	If needed, available upon request	Resident called on 2/7 to report symptoms from 2/6. Resident said that resident and resident's dogs got sick (nausea & vomiting).	Advised to consult personal physician.
8	If needed, available upon request	Reported three people in household with symptoms of diarrhea and nausea.	Advised to consult personal physician.

(CONFIDENTIAL AND PRIVATE INFORMATION)

ADMINISTRATIVE ORDER #13

The Supplier shall compile an illness report including data collected by the Supplier, Utah Poison Control, and Salt Lake County Health Department and follow-up actions. The Supplier shall submit this report to the Director within 20 days of issuance of this Order.

SALT LAKE COUNTY HEALTH DEPARTMENT:

SALT LAKE COUNTY
HEALTH DEPARTMENT

Since 2/7/19 SLCo Infectios Disease has handled the following Symptomatic Persons Related to the Sandy City Water Event as of 2/28/19 (Final Update)	Total	Percent
Households Reporting Symptomatic Members	16	100.0%
Households Contacted and Provided Education/Follow up	16	100.0%
Average Household Size(Range)	2(2-6)	NA
Persons Reporting at One or More Symptoms	40	100.0%
Reported Nausea	*28*	*70.0%*
Reported Abdominial Pain	*24*	*60.0%*
Reported Vomiting	*16*	*40.0%*
Reported Headache	*7*	*17.5%*
Reprted Diarrhea	*6*	*15.0%*
Reported Dry, Burning, Sore Mouth	*5*	*12.5%*
Reported Fatigue	*4*	*10.0%*
Persons who Symptoms have Resolved	40	100.0%
Persons with Ongoing Symptoms	0	0.0%

HEALTH
UNIVERSITY OF UTAH

Utah Poison Control Center
College of Pharmacy
30 South 2000 East, Suite 4540
Salt Lake City, UT 84112
801-587-0600

March 15, 2019

Abi Holt
Business Manager
Sandy Public Utilities
10000 S. Centennial Parkway
Sandy, UT 84070

Dear Ms. Holt:

As per your request, this letter includes data on the number of cases the Utah Poison Control Center (UPCC) was consulted on related to concerns about fluoride, lead, copper and other metals as a result of the hyperfluoridation incident in Sandy on February 5th. I am able to provide aggregate information only. It is very likely that there is overlap in the cases reported to the UPCC and the Salt Lake County Health Department.

The UPCC logged 316 cases between 2/7/2019-3/11/2019 related to the Sandy City water incident. The breakdown of case type is as follows:

Human exposures	266	84.2%
Animal exposures	11	3.5%
Information calls	39	12.3%

The remainder of this report relates to the human exposures.

Follow-up calls were conducted on a number of the cases – including some cases that were followed multiple times. Follow-up calls are normally conducted to ensure that the situation is resolving. Follow-up calls were conducted in 185 (69.5%) of cases ranging in number from 1-10 follow-up calls. Initial calls to the poison center involved multiple patients in 67 incidents involving a total of 183 cases. It is not known whether the multiple cases involved people in the same household.

A total of 184 human exposures reported one or more adverse effects, of which 23 were thought to be unrelated by the specialist in poison information consulted on the case. Of the 161 cases with adverse effects that were possibly related to the contaminated water, there were 381 total adverse effects were documented. More than one adverse effect was documented in some cases. Adverse effects were predominately gastrointestinal in nature (294; 77.2%). Other categories of adverse effects that were possibly related included dermal (5; 1.3%); neurologic (51; 13.4%); urinary (2; 0.5%) and respiratory (1; 0.3%). An additional 28 adverse effects were documented in an "other miscellaneous" category.

The majority of cases were manage onsite/non-healthcare facility (196; 73.7%). In 21 (7.9%) of cases the person was already in a healthcare facility at the time of the call. The poison center referred 38 (14.3%) people to a healthcare facility for evaluation, of which 18 heeded our recommendation. All 18 were treated and released. The management site was unknown in 11 cases. The majority (163; 61%) of human exposure cases were followed to a known outcome. In six cases no follow-up was conducted as there was deemed to be no risk for an adverse effect. In 77 (29.0%) of cases, minimal adverse effects were expected and follow-up was not possible. In 20 (7.5%) cases the adverse effects were felt to be unrelated to exposure to contaminated water.

I hope you find this information helpful. Please do not hesitate to contact me if you have any questions or concerns.

Sincerely,

Barbara Insley Crouch, PharmD, MSPH
Executive Director

Cc: Michael J. Moss, MD, Medical director
Gary Edwards, MS, Director, Salt Lake County Health Department
Dagmar Vitek, MD, Deputy Director, Salt Lake County Health Department

REGULATORS IN SERVICE

#1 A-1 HIGH BENCH > 10" VALVE OPEN

#2 GRANITE — LOSTWOOD - OPEN; PHIL'S VALVE - OPEN
PEPPERWOOD P.E.V. - OPEN

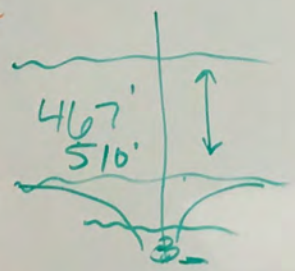
#3 HAND — ALBION - 80#; GRANITE - Sing
98th & 13th EV - 15%
SOUTHEAST P.O.M.A. - 333 gpm

#4 FLAT IRON — 86TH & 13TH - 13 %
GRASSY KNOLL - 62#
FLAT IRON B.O. - 112#
VALLEY VIEW B.O. - 135#

#5 ZONE 5
SEGO LILY - 1,700 GPM
MUFFLER - 80#
8600 S. 1050 E. - SING
BUSCHNELL - SING
8175 S. 1000 E. - Sing 68#
LAZON - Valved off
FALLBROOK -
11400 S. 700 E. - OPEN/SING + 75#

#6 GRANITE MESA
9400 S. 150 E. - Closed
9150 S. 150 E. - CLOSED FOR WILLIS
JORDAN HIGH - 1/3 OPEN 76 PSI
MAIN ST. - CLOSED
8800 S. 150 E. - Barely OPEN
10600 S. 300 E. - Closed
G.M.E.V. - 6 %
11400 S. 350 E. - CLOSED
E.V. - 0 %

- MANUAL = SET VALVE POSITION VARIABLE FLOW
- AUTO = VARIABLE VALVE POSITION SET FLOW



CLOSED ZONES

A-1 CLOSED
3332 E. LITTLE COTTONWOOD RD. - 85#

PEPPERWOOD CLOSED - 110#
2600 E. PEPPERWOOD DR. - 65#

ZONE 3N
NEW CASTLE - 65#
SNOW MTN. - 65#

SOUTHEAST CLOSED (13TH F. REGS)
11000 S. - 64#
Alta Heights - SING
11400 S. - CLOSED
INDIAN HILLS - CLOSED
HIDDEN VALLEY - 64#
SPRING RIDGE - Sing
CHERRY Knoll - Sing
STORM MTN - 120#
10600 S Valved off

0-5 YRS	176 HRS	P.T.O + 40 HRS ML
6-10 YRS	216 HRS	P.T.O + 40 HRS ML
11+ YRS	260 HRS	P.T.O + 40 HRS ML

CURRENT SICK CONVERTS TO MEDICAL LEAVE

FREEZE CURRENT BALANCES

Sandy City Public Utilities - Treatment Plants

State ID #	Well Name	Address	Fluoride	Chlorine
TP004	Granite Mesa	8858 S. 1240 E.	X	
TP012	Severson	8396 S. Grambling Way	X	X
TP015	Palmer	9140 S. Sterling Dr.	X	X
TP018	Canyon Village	1822 E. Southbridge Way	X	X
TP021	Wallin	590 E. 8680 S.	X	X
TP023	Wildflower	9895 S. Wildflower Rd.	X	
TP028	Alta Canyon	2010 E. Village Point Way	X	
TP030	Pepperwood	2188 E. Pepperwood Dr.	X	X
TP031	Brandon Park	1900 E. 11400 S.	X	
TP032	Dimple Dell	1929 E. Dimple Dell Dr.	X	
TP034	Lone Hollow	#42 Lone Hollow Dr.	X	
TP035	Paradise Valley	1975 E. Justin Park Dr.	X	

Column1	Column2	Column3	Column4
Location	Downstream Pressure	Upstream Pressure	Status
1263 E. 10600 S.	Valved off	Valved off	Not running
1265 E. 11000 S.	66#	112#	Running
1287 E. Alta Heights Dr.	62#	112#	Not running
1226 E. 11400 S.	Valved off	Valved off	Not running
1203 E. Cherry Knoll	74#	122#	Not running
1213 E. Sanders Rd.	70#	119#	Not running
1283 E. Hidden Valley Rd.	60#	No Reading	Running
1298 E. Sping Ridge Rd.	83#	128#	Not running

Metro Southeast Connection Flow (MGD)

t_stamp	D/OUTPUT
2/5/2019 10:00	0.37
2/5/2019 10:14	0.38
2/5/2019 10:14	0.47
2/5/2019 10:29	0.45
2/5/2019 10:29	0.37
2/5/2019 10:43	0.41
2/5/2019 10:43	0.49
2/5/2019 10:58	0.44
2/5/2019 10:58	0.39
2/5/2019 11:13	0.45
2/5/2019 11:13	0.39
2/5/2019 11:27	0.39
2/5/2019 11:27	0.46
2/5/2019 11:42	0.45
2/5/2019 11:42	0.4
2/5/2019 11:56	0.45
2/5/2019 11:56	0.38
2/5/2019 12:11	0.46
2/5/2019 12:11	0.39
2/5/2019 12:26	0.41
2/5/2019 12:26	0.44
2/5/2019 12:40	0.4
2/5/2019 12:40	0.46
2/5/2019 12:55	0.38
2/5/2019 12:55	0.45
2/5/2019 13:09	0.46
2/5/2019 13:09	0.4
2/5/2019 13:24	0.46
2/5/2019 13:24	0.39
2/5/2019 13:39	0.4
2/5/2019 13:39	0.46
2/5/2019 13:53	0.46
2/5/2019 13:53	0.41
2/5/2019 14:08	0.47
2/5/2019 14:08	0.4
2/5/2019 14:22	0.42
2/5/2019 14:22	0.49
2/5/2019 14:37	0.44
2/5/2019 14:37	0.4
2/5/2019 14:52	0.41
2/5/2019 14:52	0.45
2/5/2019 15:06	0.4
2/5/2019 15:06	0.46
2/5/2019 15:21	0.46
2/5/2019 15:21	0.41
2/5/2019 15:35	0.41
2/5/2019 15:35	0.45
2/5/2019 15:50	0.38
2/5/2019 15:50	0.47
2/5/2019 16:05	0.4
2/5/2019 16:05	0.45

2/5/2019 16:19	0.45
2/5/2019 16:19	0.41
2/5/2019 16:34	0.44
2/5/2019 16:34	0.4
2/5/2019 16:48	0.38
2/5/2019 16:48	0.45
2/5/2019 17:03	0.44
2/5/2019 17:03	0.41
2/5/2019 17:18	0.4
2/5/2019 17:18	0.46
2/5/2019 17:32	0.46
2/5/2019 17:32	0.38
2/5/2019 17:47	0.39
2/5/2019 17:47	0.45
2/5/2019 18:01	0.45
2/5/2019 18:01	0.4
2/5/2019 18:16	0.45
2/5/2019 18:16	0.41
2/5/2019 18:31	0.41
2/5/2019 18:31	0.45
2/5/2019 18:45	0.44
2/5/2019 18:45	0.4
2/5/2019 19:00	0.41
2/5/2019 19:00	0.44
2/5/2019 19:14	0.41
2/5/2019 19:14	0.45
2/5/2019 19:29	0.41
2/5/2019 19:29	0.46
2/5/2019 19:44	0.41
2/5/2019 19:44	0.46
2/5/2019 19:58	0.41
2/5/2019 19:58	0.44
2/5/2019 20:13	0.45
2/5/2019 20:13	0.41
2/5/2019 20:27	0.39
2/5/2019 20:27	0.46
2/5/2019 20:42	0.42
2/5/2019 20:42	0.45
2/5/2019 20:57	0.4
2/5/2019 20:57	0.45
2/5/2019 21:11	0.41
2/5/2019 21:11	0.45
2/5/2019 21:26	0.44
2/5/2019 21:26	0.41
2/5/2019 21:40	0.41
2/5/2019 21:40	0.46
2/5/2019 21:55	0.4
2/5/2019 21:55	0.46
2/5/2019 22:10	0.41
2/5/2019 22:10	0.47
2/5/2019 22:24	0.46
2/5/2019 22:24	0.4

2/5/2019 22:39	0.42
2/5/2019 22:39	0.46
2/5/2019 22:53	0.42
2/5/2019 22:53	0.45
2/5/2019 23:08	0.46
2/5/2019 23:08	0.41
2/5/2019 23:23	0.42
2/5/2019 23:23	0.45
2/5/2019 23:37	0.45
2/5/2019 23:37	0.41
2/5/2019 23:52	0.45
2/5/2019 23:52	0
2/6/2019 0:06	0.4
2/6/2019 0:06	0.45
2/6/2019 0:21	0.44
2/6/2019 0:21	0.37
2/6/2019 0:36	0.41
2/6/2019 0:36	0.44
2/6/2019 0:50	0.41
2/6/2019 0:50	0.44
2/6/2019 1:05	0.41
2/6/2019 1:05	0.44
2/6/2019 1:19	0.45
2/6/2019 1:19	0.41
2/6/2019 1:34	0.41
2/6/2019 1:34	0.44
2/6/2019 1:49	0.44
2/6/2019 1:49	0.41
2/6/2019 2:03	0.44
2/6/2019 2:03	0.4
2/6/2019 2:18	0.41
2/6/2019 2:18	0.44
2/6/2019 2:32	0.41
2/6/2019 2:32	0.44
2/6/2019 2:47	0.45
2/6/2019 2:47	0.4
2/6/2019 3:02	0.4
2/6/2019 3:02	0.44
2/6/2019 3:16	0.44
2/6/2019 3:16	0.4
2/6/2019 3:31	0.45
2/6/2019 3:31	0.41
2/6/2019 3:45	0.4
2/6/2019 3:45	0.45
2/6/2019 4:00	0.41
2/6/2019 4:00	0.44
2/6/2019 4:15	0.44
2/6/2019 4:15	0.4
2/6/2019 4:29	0.45
2/6/2019 4:29	0.41
2/6/2019 4:44	0.44
2/6/2019 4:44	0.41

2/6/2019 4:58	0.41
2/6/2019 4:58	0.46
2/6/2019 5:13	0.4
2/6/2019 5:13	0.44
2/6/2019 5:28	0.44
2/6/2019 5:28	0.4
2/6/2019 5:42	0.39
2/6/2019 5:42	0.45
2/6/2019 5:57	0.41
2/6/2019 5:57	0.46
2/6/2019 6:11	0.45
2/6/2019 6:11	0.4
2/6/2019 6:26	0.45
2/6/2019 6:26	0.4
2/6/2019 6:41	0.47
2/6/2019 6:41	0.38
2/6/2019 6:55	0.44
2/6/2019 6:55	0.39
2/6/2019 7:10	0.4
2/6/2019 7:10	0.47
2/6/2019 7:24	0.41
2/6/2019 7:24	0.44
2/6/2019 7:39	0.4
2/6/2019 7:39	0.43
2/6/2019 7:54	0.43
2/6/2019 7:54	0.4
2/6/2019 8:08	0.38
2/6/2019 8:08	0.45
2/6/2019 8:23	0.4
2/6/2019 8:23	0.44
2/6/2019 8:37	0.45
2/6/2019 8:37	0.4
2/6/2019 8:52	0.39
2/6/2019 8:52	0.46
2/6/2019 9:07	0.46
2/6/2019 9:07	0.39
2/6/2019 9:21	0.45
2/6/2019 9:21	0.39
2/6/2019 9:36	0.4
2/6/2019 9:36	0.45
2/6/2019 9:50	0.39
2/6/2019 9:50	0.44
2/6/2019 10:05	0.44
2/6/2019 10:05	0.39
2/6/2019 10:20	0.41
2/6/2019 10:20	0.45
2/6/2019 10:34	0.44
2/6/2019 10:34	0.38
2/6/2019 10:49	0.4
2/6/2019 10:49	0.45
2/6/2019 11:03	0.39
2/6/2019 11:03	0.45

2/6/2019 11:18	0.4
2/6/2019 11:18	0.44
2/6/2019 11:33	0.4
2/6/2019 11:33	0.46
2/6/2019 11:47	0.39
2/6/2019 11:47	0.46
2/6/2019 12:02	0.41
2/6/2019 12:02	0.45
2/6/2019 12:16	0.4
2/6/2019 12:16	0.45
2/6/2019 12:31	0.44
2/6/2019 12:31	0.41
2/6/2019 12:46	0.41
2/6/2019 12:46	0.44
2/6/2019 13:00	0.4
2/6/2019 13:00	0.45
2/6/2019 13:15	0.41
2/6/2019 13:15	0.45
2/6/2019 13:29	0.41
2/6/2019 13:29	0.45
2/6/2019 13:44	0.41
2/6/2019 13:44	0.44
2/6/2019 13:59	0.44
2/6/2019 13:59	0.4
2/6/2019 14:13	0.4
2/6/2019 14:13	0.46
2/6/2019 14:28	0.45
2/6/2019 14:28	0.39
2/6/2019 14:42	0.44
2/6/2019 14:42	0.35
2/6/2019 14:57	0.41
2/6/2019 14:57	0.45
2/6/2019 15:12	0.41
2/6/2019 15:12	0.44
2/6/2019 15:26	0.45
2/6/2019 15:26	0.39
2/6/2019 15:41	0.39
2/6/2019 15:41	0.46
2/6/2019 15:55	0.4
2/6/2019 15:55	0.46
2/6/2019 16:10	0.44
2/6/2019 16:10	0.4
2/6/2019 16:25	0.44
2/6/2019 16:25	0.39
2/6/2019 16:39	0.45
2/6/2019 16:39	0.39
2/6/2019 16:54	0.41
2/6/2019 16:54	0.44
2/6/2019 17:08	0.45
2/6/2019 17:08	0.39
2/6/2019 17:23	0.4
2/6/2019 17:23	0.45

2/6/2019 17:38	0.41
2/6/2019 17:38	0.45
2/6/2019 17:52	0.41
2/6/2019 17:52	0.45
2/6/2019 18:07	0.4
2/6/2019 18:07	0.45
2/6/2019 18:21	0.42
2/6/2019 18:21	0.45
2/6/2019 18:36	0.4
2/6/2019 18:36	0.47
2/6/2019 18:51	0.45
2/6/2019 18:51	0.4
2/6/2019 19:05	0.41
2/6/2019 19:05	0.44
2/6/2019 19:20	0.4
2/6/2019 19:20	0.46
2/6/2019 19:34	0.45
2/6/2019 19:34	0.4
2/6/2019 19:49	0.44
2/6/2019 19:49	0.41
2/6/2019 20:04	0.45
2/6/2019 20:04	0.41
2/6/2019 20:18	0.41
2/6/2019 20:18	0.46
2/6/2019 20:33	0.44
2/6/2019 20:33	0.4
2/6/2019 20:47	0.45
2/6/2019 20:47	0.4
2/6/2019 21:02	0.45
2/6/2019 21:02	0.41
2/6/2019 21:17	0.41
2/6/2019 21:17	0.46
2/6/2019 21:31	0.46
2/6/2019 21:31	0.41
2/6/2019 21:46	0.42
2/6/2019 21:46	0.45
2/6/2019 22:00	0.45
2/6/2019 22:00	0.41
2/6/2019 22:15	0.41
2/6/2019 22:15	0.48
2/6/2019 22:30	0.45
2/6/2019 22:30	0.4
2/6/2019 22:44	0.41
2/6/2019 22:44	0.45
2/6/2019 22:59	0.45
2/6/2019 22:59	0.4
2/6/2019 23:13	0.4
2/6/2019 23:13	0.45
2/6/2019 23:28	0.41
2/6/2019 23:28	0.46
2/6/2019 23:43	0.45
2/6/2019 23:43	0.41

2/6/2019 23:57	0
2/6/2019 23:57	0.45
2/7/2019 0:12	0.41
2/7/2019 0:12	0.45
2/7/2019 0:26	0.41
2/7/2019 0:26	0.46
2/7/2019 0:41	0.46
2/7/2019 0:41	0.41
2/7/2019 0:56	0.45
2/7/2019 0:56	0.42
2/7/2019 1:10	0.41
2/7/2019 1:10	0.45
2/7/2019 1:25	0.45
2/7/2019 1:25	0.41
2/7/2019 1:39	0.41
2/7/2019 1:39	0.45
2/7/2019 1:54	0.45
2/7/2019 1:54	0.41
2/7/2019 2:09	0.44
2/7/2019 2:09	0.42
2/7/2019 2:23	0.45
2/7/2019 2:23	0.41
2/7/2019 2:38	0.41
2/7/2019 2:38	0.46
2/7/2019 2:52	0.41
2/7/2019 2:52	0.45
2/7/2019 3:07	0.42
2/7/2019 3:07	0.45
2/7/2019 3:22	0.41
2/7/2019 3:22	0.45
2/7/2019 3:36	0.45
2/7/2019 3:36	0.41
2/7/2019 3:51	0.46
2/7/2019 3:51	0.4
2/7/2019 4:05	0.41
2/7/2019 4:05	0.46
2/7/2019 4:20	0.44
2/7/2019 4:20	0.41
2/7/2019 4:35	0.44
2/7/2019 4:35	0.41
2/7/2019 4:49	0.45
2/7/2019 4:49	0.42
2/7/2019 5:04	0.45
2/7/2019 5:04	0.41
2/7/2019 5:18	0.45
2/7/2019 5:18	0.41
2/7/2019 5:33	0.44
2/7/2019 5:33	0.41
2/7/2019 5:48	0.41
2/7/2019 5:48	0.46
2/7/2019 6:02	0.42
2/7/2019 6:02	0.45

2/7/2019 6:17	0.44
2/7/2019 6:17	0.4
2/7/2019 6:31	0.41
2/7/2019 6:31	0.45
2/7/2019 6:46	0.41
2/7/2019 6:46	0.45
2/7/2019 7:01	0.46
2/7/2019 7:01	0.41
2/7/2019 7:15	0.47
2/7/2019 7:15	0.41
2/7/2019 7:30	0.44
2/7/2019 7:30	0.39
2/7/2019 7:44	0.44
2/7/2019 7:44	0.41
2/7/2019 7:59	0.4
2/7/2019 7:59	0.45
2/7/2019 8:14	0.41
2/7/2019 8:14	0.44
2/7/2019 8:28	0.41
2/7/2019 8:28	0.45
2/7/2019 8:43	0.41
2/7/2019 8:43	0.46
2/7/2019 8:57	0.44
2/7/2019 8:57	0.39
2/7/2019 9:12	0.44
2/7/2019 9:12	0.4
2/7/2019 9:27	0.44
2/7/2019 9:27	0.39
2/7/2019 9:41	0.46
2/7/2019 9:41	0.41
2/7/2019 9:56	0.4
2/7/2019 9:56	0.45
2/7/2019 10:10	0.46
2/7/2019 10:10	0.4
2/7/2019 10:25	0.41
2/7/2019 10:25	0.47
2/7/2019 10:40	0.41
2/7/2019 10:40	0.45
2/7/2019 10:54	0.45
2/7/2019 10:54	0.39
2/7/2019 11:09	0.47
2/7/2019 11:09	0.36
2/7/2019 11:23	0.39
2/7/2019 11:23	0.46
2/7/2019 11:38	0.52
2/7/2019 11:38	0.41
2/7/2019 11:53	0.4
2/7/2019 11:53	0.5
2/7/2019 12:07	0.44
2/7/2019 12:07	0.4
2/7/2019 12:22	0.41
2/7/2019 12:22	0.46

2/7/2019 12:36	0.39
2/7/2019 12:36	0.46
2/7/2019 12:51	0.46
2/7/2019 12:51	0.39
2/7/2019 13:06	0.4
2/7/2019 13:06	0.48
2/7/2019 13:20	0.39
2/7/2019 13:20	0.47
2/7/2019 13:35	0.47
2/7/2019 13:35	0.41
2/7/2019 13:49	0.41
2/7/2019 13:49	0.5
2/7/2019 14:04	0.5
2/7/2019 14:04	0.45
2/7/2019 14:19	0.47
2/7/2019 14:19	0.42
2/7/2019 14:33	0.47
2/7/2019 14:33	0.41
2/7/2019 14:48	0.42
2/7/2019 14:48	0.48
2/7/2019 15:02	0.43
2/7/2019 15:02	0.48
2/7/2019 15:17	0.44
2/7/2019 15:17	0.46
2/7/2019 15:32	0.49
2/7/2019 15:32	0.43
2/7/2019 15:46	0.43
2/7/2019 15:46	0.56
2/7/2019 16:01	0.51
2/7/2019 16:01	0.42
2/7/2019 16:15	0.48
2/7/2019 16:15	0.41
2/7/2019 16:30	0.42
2/7/2019 16:30	0.47
2/7/2019 16:45	0.43
2/7/2019 16:45	0.48
2/7/2019 16:59	0.5
2/7/2019 16:59	0.42
2/7/2019 17:14	0.47
2/7/2019 17:14	0.42
2/7/2019 17:28	0.46
2/7/2019 17:28	0.42
2/7/2019 17:43	0.43
2/7/2019 17:43	0.48
2/7/2019 17:58	0.49
2/7/2019 17:58	0.43
2/7/2019 18:12	0.47
2/7/2019 18:12	0.42
2/7/2019 18:27	0.47
2/7/2019 18:27	0.43
2/7/2019 18:41	0.48
2/7/2019 18:41	0.43

2/7/2019 18:56	0.41
2/7/2019 18:56	0.46
2/7/2019 19:11	0.43
2/7/2019 19:11	0.47
2/7/2019 19:25	0.47
2/7/2019 19:25	0.41
2/7/2019 19:40	0.46
2/7/2019 19:40	0.43
2/7/2019 19:54	0.47
2/7/2019 19:54	0.42
2/7/2019 20:09	0.48
2/7/2019 20:09	0.43
2/7/2019 20:24	0.46
2/7/2019 20:24	0.42
2/7/2019 20:38	0.43
2/7/2019 20:38	0.47
2/7/2019 20:53	0.47
2/7/2019 20:53	0.42
2/7/2019 21:07	0.43
2/7/2019 21:07	0.47
2/7/2019 21:22	0.47
2/7/2019 21:22	0.43
2/7/2019 21:37	0.47
2/7/2019 21:37	0.42
2/7/2019 21:51	0.43
2/7/2019 21:51	0.46
2/7/2019 22:06	0.42
2/7/2019 22:06	0.48
2/7/2019 22:20	0.47
2/7/2019 22:20	0.43
2/7/2019 22:35	0.46
2/7/2019 22:35	0.42
2/7/2019 22:50	0.47
2/7/2019 22:50	0.42
2/7/2019 23:04	0.46
2/7/2019 23:04	0.42
2/7/2019 23:19	0.44
2/7/2019 23:19	0.48
2/7/2019 23:33	0.47
2/7/2019 23:33	0.42
2/7/2019 23:48	0.47
2/7/2019 23:48	0
2/8/2019 0:03	0.43
2/8/2019 0:03	0.46
2/8/2019 0:17	0.43
2/8/2019 0:17	0.48
2/8/2019 0:32	0.42
2/8/2019 0:32	0.47
2/8/2019 0:46	0.49
2/8/2019 0:46	0.41
2/8/2019 1:01	0.46
2/8/2019 1:01	0.41

2/8/2019 1:16	0.42
2/8/2019 1:16	0.47
2/8/2019 1:30	0.47
2/8/2019 1:30	0.44
2/8/2019 1:45	0.43
2/8/2019 1:45	0.47
2/8/2019 1:59	0.47
2/8/2019 1:59	0.43
2/8/2019 2:14	0.46
2/8/2019 2:14	0.43
2/8/2019 2:29	0.46
2/8/2019 2:29	0.43
2/8/2019 2:43	0.44
2/8/2019 2:43	0.47
2/8/2019 2:58	0.46
2/8/2019 2:58	0.42
2/8/2019 3:12	0.47
2/8/2019 3:12	0.42
2/8/2019 3:27	0.43
2/8/2019 3:27	0.47
2/8/2019 3:42	0.43
2/8/2019 3:42	0.46
2/8/2019 3:56	0.42
2/8/2019 3:56	0.46
2/8/2019 4:11	0.42
2/8/2019 4:11	0.46
2/8/2019 4:25	0.42
2/8/2019 4:25	0.47
2/8/2019 4:40	0.46
2/8/2019 4:40	0.43
2/8/2019 4:55	0.45
2/8/2019 4:55	0.42
2/8/2019 5:09	0.42
2/8/2019 5:09	0.47
2/8/2019 5:24	0.46
2/8/2019 5:24	0.41
2/8/2019 5:38	0.45
2/8/2019 5:38	0.4
2/8/2019 5:53	0.46
2/8/2019 5:53	0.42
2/8/2019 6:08	0.41
2/8/2019 6:08	0.46
2/8/2019 6:22	0.46
2/8/2019 6:22	0.4
2/8/2019 6:37	0.41
2/8/2019 6:37	0.49
2/8/2019 6:51	0.41
2/8/2019 6:51	0.46
2/8/2019 7:06	0.41
2/8/2019 7:06	0.46
2/8/2019 7:21	0.47
2/8/2019 7:21	0.43

2/8/2019 7:35	0.41
2/8/2019 7:35	0.47
2/8/2019 7:50	0.42
2/8/2019 7:50	0.46
2/8/2019 8:04	0.43
2/8/2019 8:04	0.47
2/8/2019 8:19	0.45
2/8/2019 8:19	0.41
2/8/2019 8:34	0.42
2/8/2019 8:34	0.47
2/8/2019 8:48	0.47
2/8/2019 8:48	0.4
2/8/2019 9:03	0.46
2/8/2019 9:03	0.4
2/8/2019 9:17	0.41
2/8/2019 9:17	0.46
2/8/2019 9:32	0.41
2/8/2019 9:32	0.47
2/8/2019 9:47	0.47
2/8/2019 9:47	0.42
2/8/2019 10:01	0.4
2/8/2019 10:01	0.47
2/8/2019 10:16	0.41
2/8/2019 10:16	0.46
2/8/2019 10:30	0.47
2/8/2019 10:30	0.41
2/8/2019 10:40	0.43
2/8/2019 10:40	0.46
2/8/2019 10:50	0.46
2/8/2019 10:50	0.42

Paradise Valley Well Pressure (psi)

t_stamp	Ξ/OUTPUT
2/5/2019 12:02	77.1
2/5/2019 12:16	81.5
2/5/2019 12:16	76.8
2/5/2019 12:30	80.8
2/5/2019 12:30	77.4
2/5/2019 12:45	77.2
2/5/2019 12:45	79.7
2/5/2019 12:59	79.2
2/5/2019 12:59	77.4
2/5/2019 13:14	81.4
2/5/2019 13:14	76.3
2/5/2019 13:28	76.3
2/5/2019 13:28	80.4
2/5/2019 13:43	77.6
2/5/2019 13:43	80.6
2/5/2019 13:57	80.1
2/5/2019 13:57	76.8
2/5/2019 14:11	77.6
2/5/2019 14:11	80
2/5/2019 14:26	81.6
2/5/2019 14:26	75.7
2/5/2019 14:40	80.3
2/5/2019 14:40	77.6
2/5/2019 14:55	76.6
2/5/2019 14:55	80.2
2/5/2019 15:09	81.2
2/5/2019 15:09	77.5
2/5/2019 15:24	80.2
2/5/2019 15:24	77.1
2/5/2019 15:38	80.5
2/5/2019 15:38	76.7
2/5/2019 15:52	76.4
2/5/2019 15:52	82
2/5/2019 16:07	77.3
2/5/2019 16:07	79.5
2/5/2019 16:21	79.4
2/5/2019 16:21	77.4
2/5/2019 16:36	80.1
2/5/2019 16:36	76.8
2/5/2019 16:50	78
2/5/2019 16:50	79.8
2/5/2019 17:05	77.4
2/5/2019 17:05	79.8
2/5/2019 17:19	77.3
2/5/2019 17:19	79.9
2/5/2019 17:34	79.3
2/5/2019 17:34	76.9
2/5/2019 17:48	77
2/5/2019 17:48	79.7
2/5/2019 18:02	79.7
2/5/2019 18:02	77.4

2/5/2019 18:17	78.1
2/5/2019 18:17	80.3
2/5/2019 18:31	77.4
2/5/2019 18:31	79.7
2/5/2019 18:46	77.1
2/5/2019 18:46	79.7
2/5/2019 19:00	80
2/5/2019 19:00	77.3
2/5/2019 19:15	80.3
2/5/2019 19:15	77.5
2/5/2019 19:29	77.6
2/5/2019 19:29	79.5
2/5/2019 19:43	79.3
2/5/2019 19:43	77.5
2/5/2019 19:58	79.5
2/5/2019 19:58	77.7
2/5/2019 20:12	79.4
2/5/2019 20:12	77.6
2/5/2019 20:27	79.8
2/5/2019 20:27	76.9
2/5/2019 20:41	76.9
2/5/2019 20:41	79.6
2/5/2019 20:56	77.4
2/5/2019 20:56	79.2
2/5/2019 21:10	77.8
2/5/2019 21:10	79.3
2/5/2019 21:25	77.6
2/5/2019 21:25	79.6
2/5/2019 21:39	78
2/5/2019 21:39	79.4
2/5/2019 21:53	77.3
2/5/2019 21:53	79.3
2/5/2019 22:08	77
2/5/2019 22:08	79.2
2/5/2019 22:22	79
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2/7/2019 23:13	77.3
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2/8/2019 2:06	79.1
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2/8/2019 8:07	79.1
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Wild Flower Well Pressure (psi)

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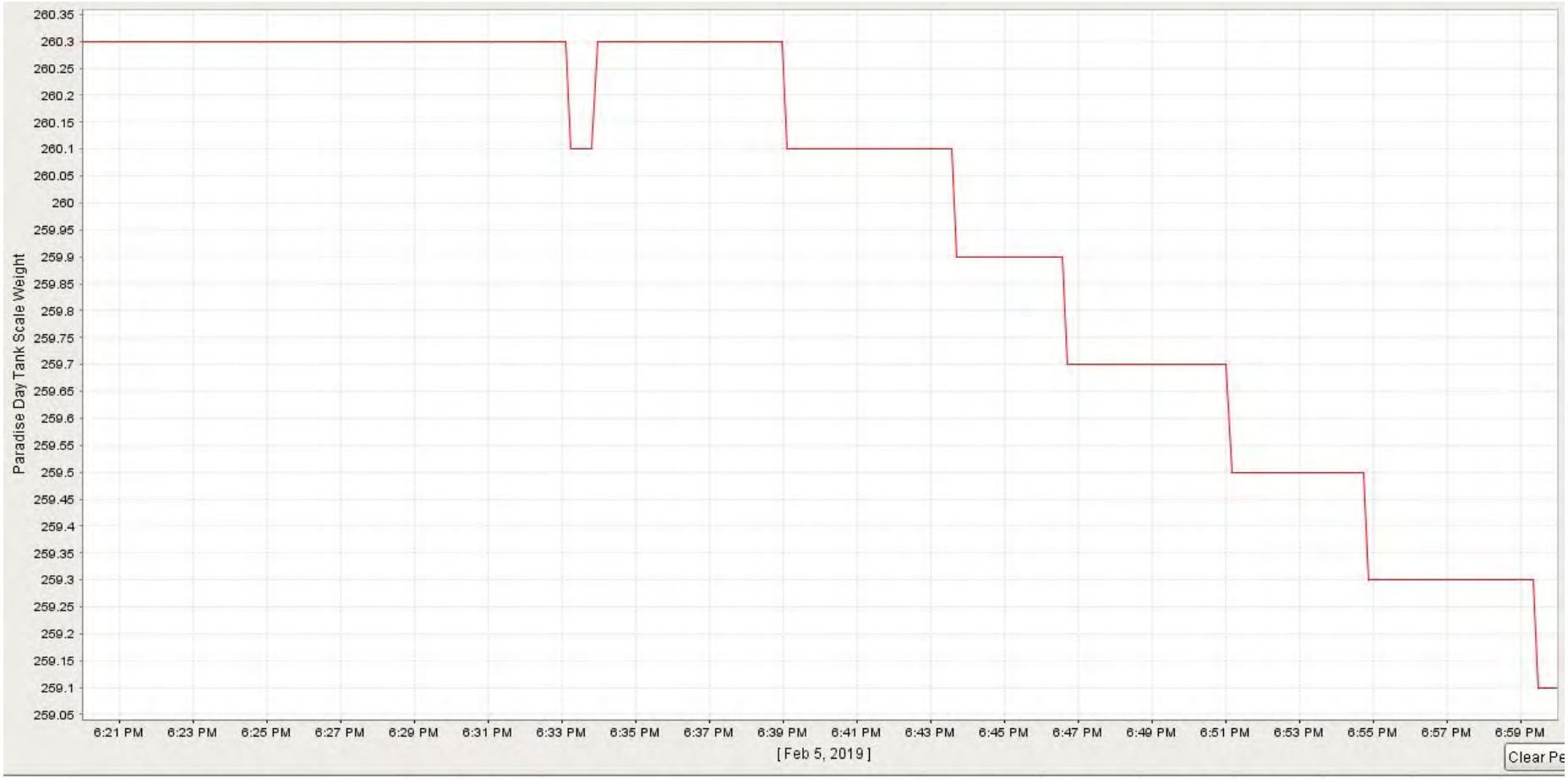
2/8/2019 11:58	109

Paradise Valley Well Fluoride Day Tank Scale (lbs)

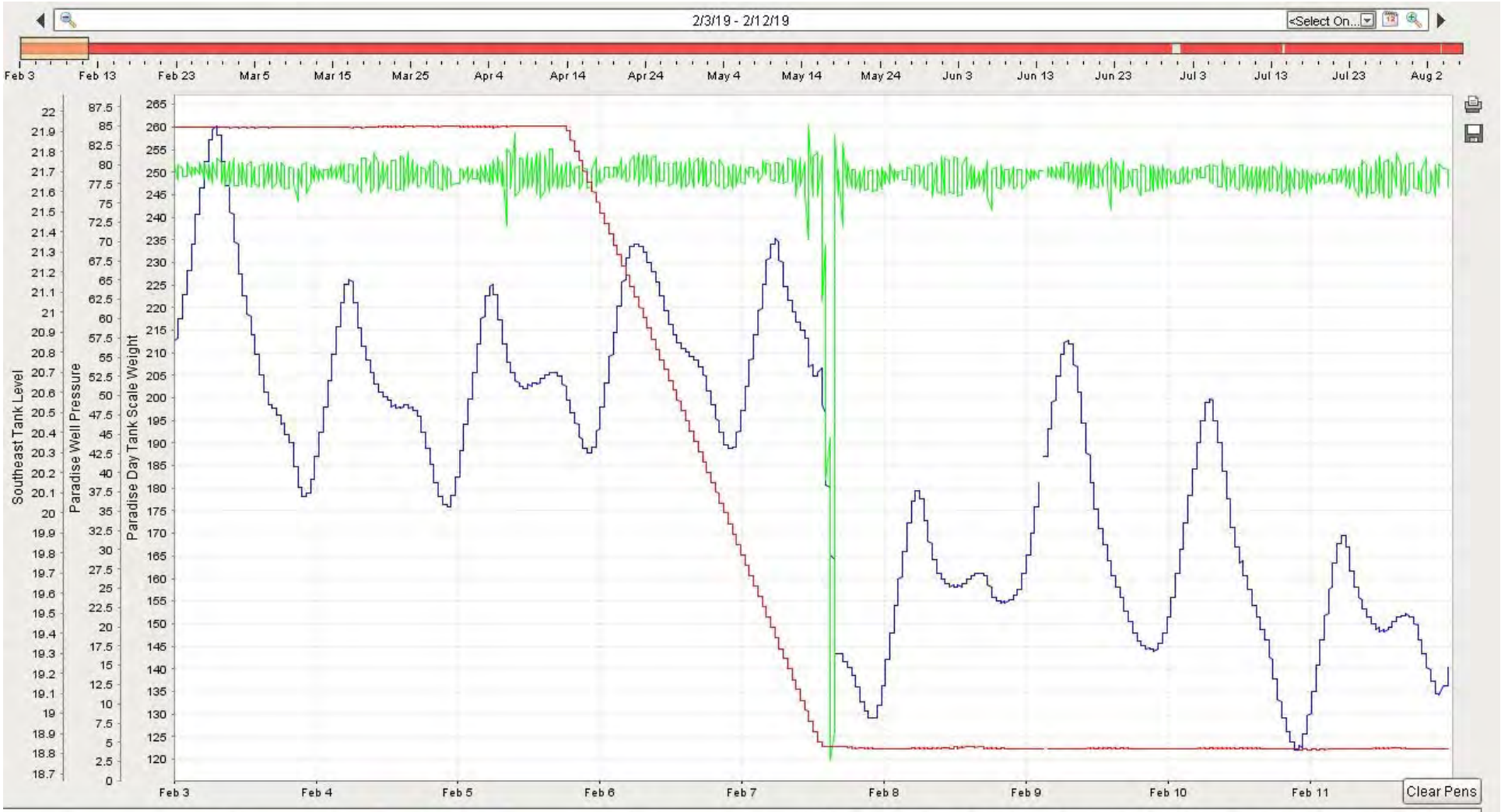


_	NAME	COLOR	PATH	PLOT	STYLE	WEIGHT	SHAPE	FILL	MIN	MAX	AVG
☑	Paradise Day Tank Scale Weight		[Ignition]DISTRIBUTION/S15_PARADIS...	1	Line w/ Gaps	1	Square	☑	259.1	260.3	259

Paradise Valley Well Fluoride Day Tank Scale (lbs)

Paradise Valley Well Fluoride Day Tank Scale (lbs)

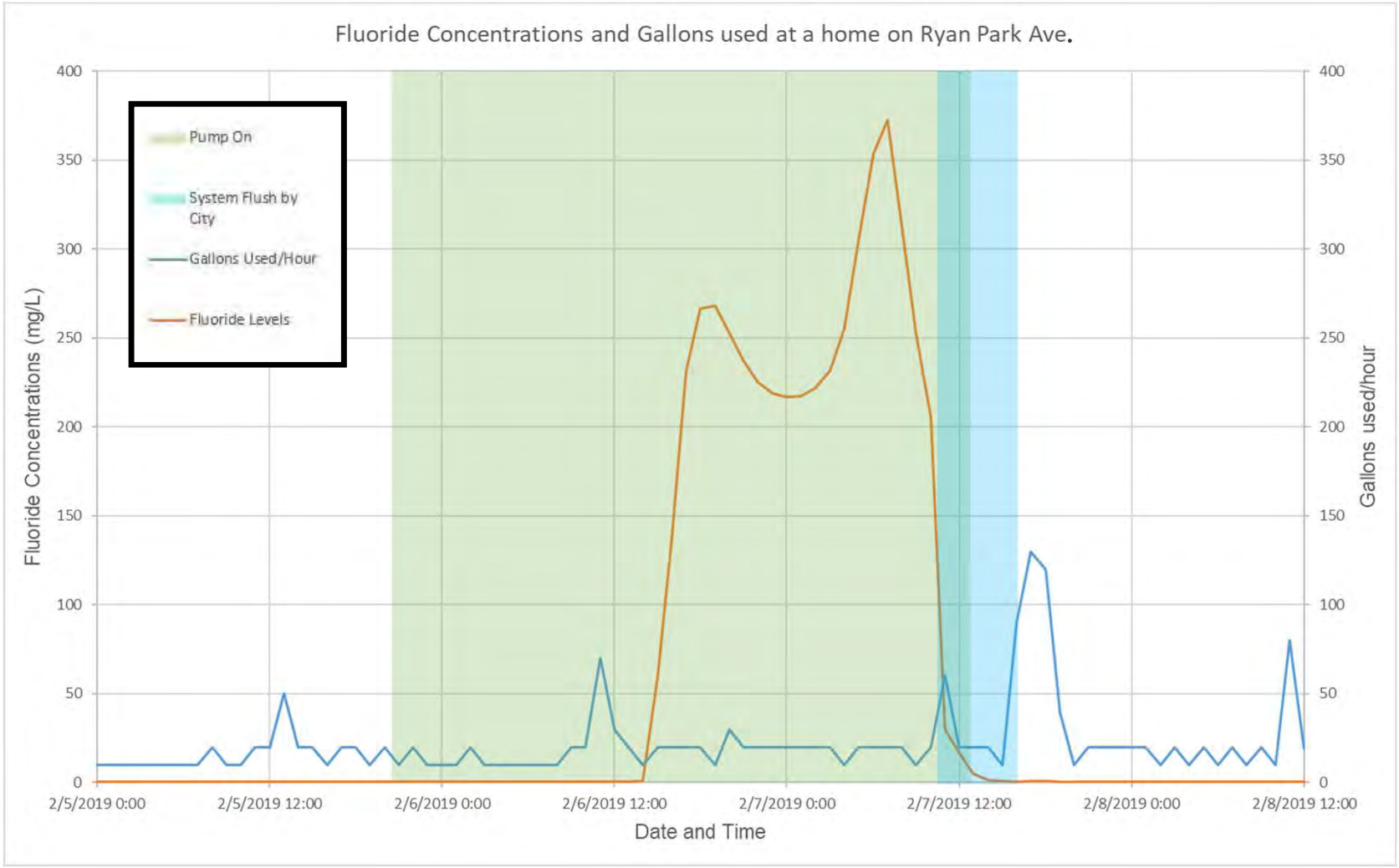
Paradise Valley Well Fluoride Day Tank Scale (lbs), Southeast Tank Water Level (ft), and Paradise Valley Well Pressure (psi)

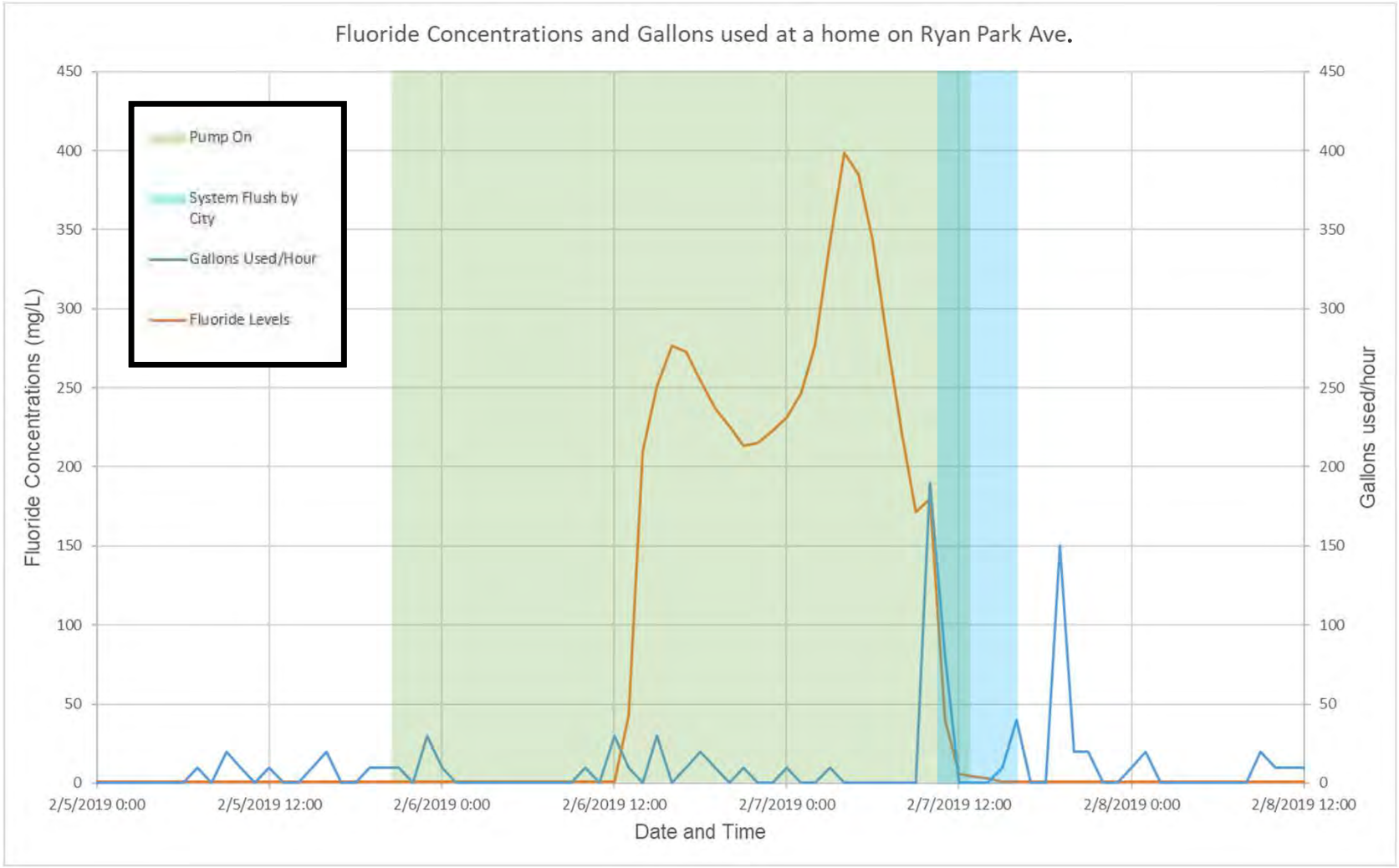


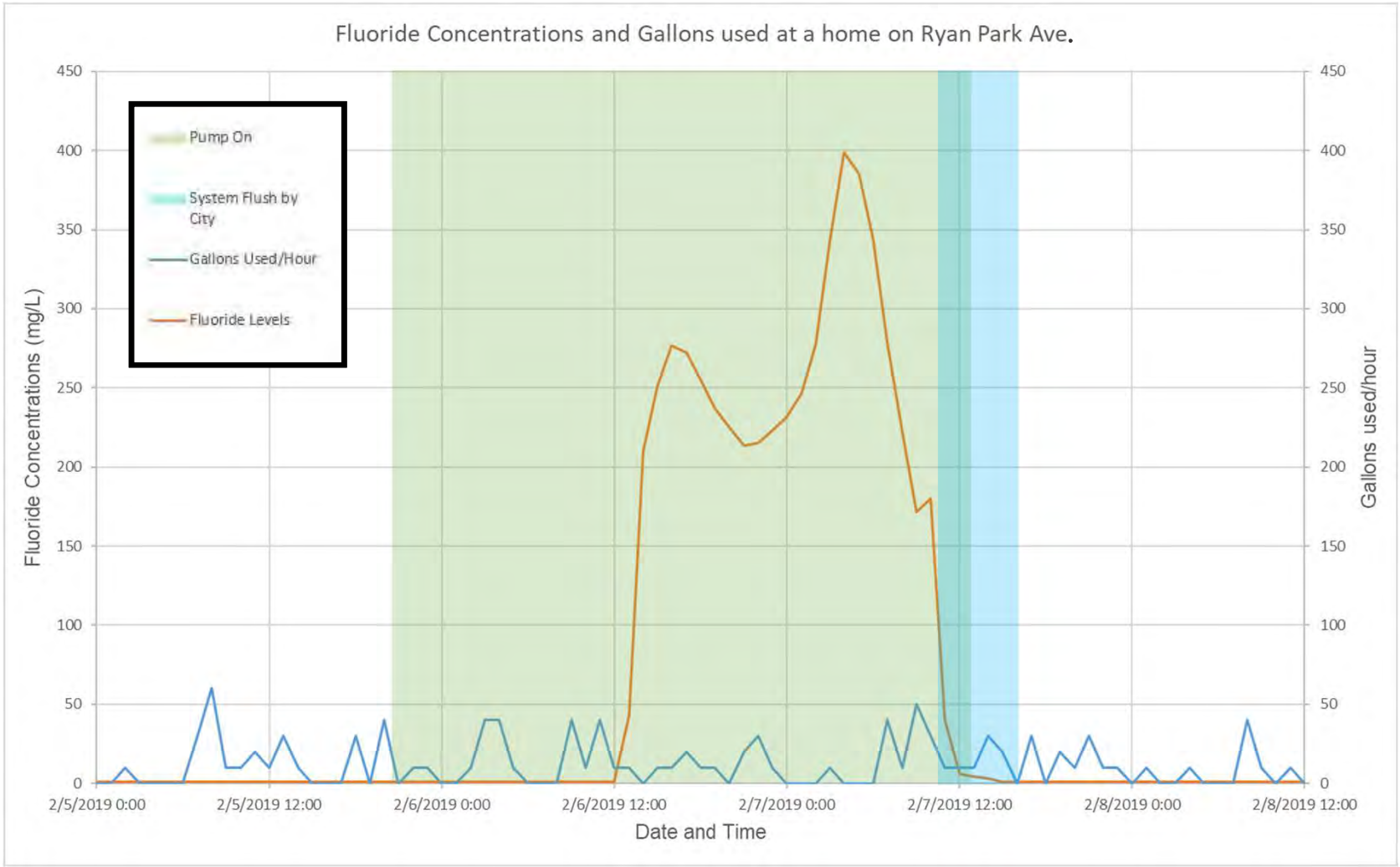
–	NAME	COLOR	PATH	PLOT	STYLE	WEIGHT	SHAPE	FILL	MIN	MAX	AVG
☑	Paradise Day Tank Scale Weight		[Ignition]DISTRIBUTION/S15_PARADIS...	1	Line w/ Gaps	1	Square	☑	2.61	260.3	178.65
☑	Southeast Tank Level		[Ignition]DISTRIBUTION/S31_SOUTHEA...	1	Line w/ Gaps	1	Square	☑	0	21.93	20.23
☑	Paradise Well Pressure		[Ignition]DISTRIBUTION/S15_PARADIS...	1	Line w/ Gaps	1	Square	☑	0.76	85	78.09

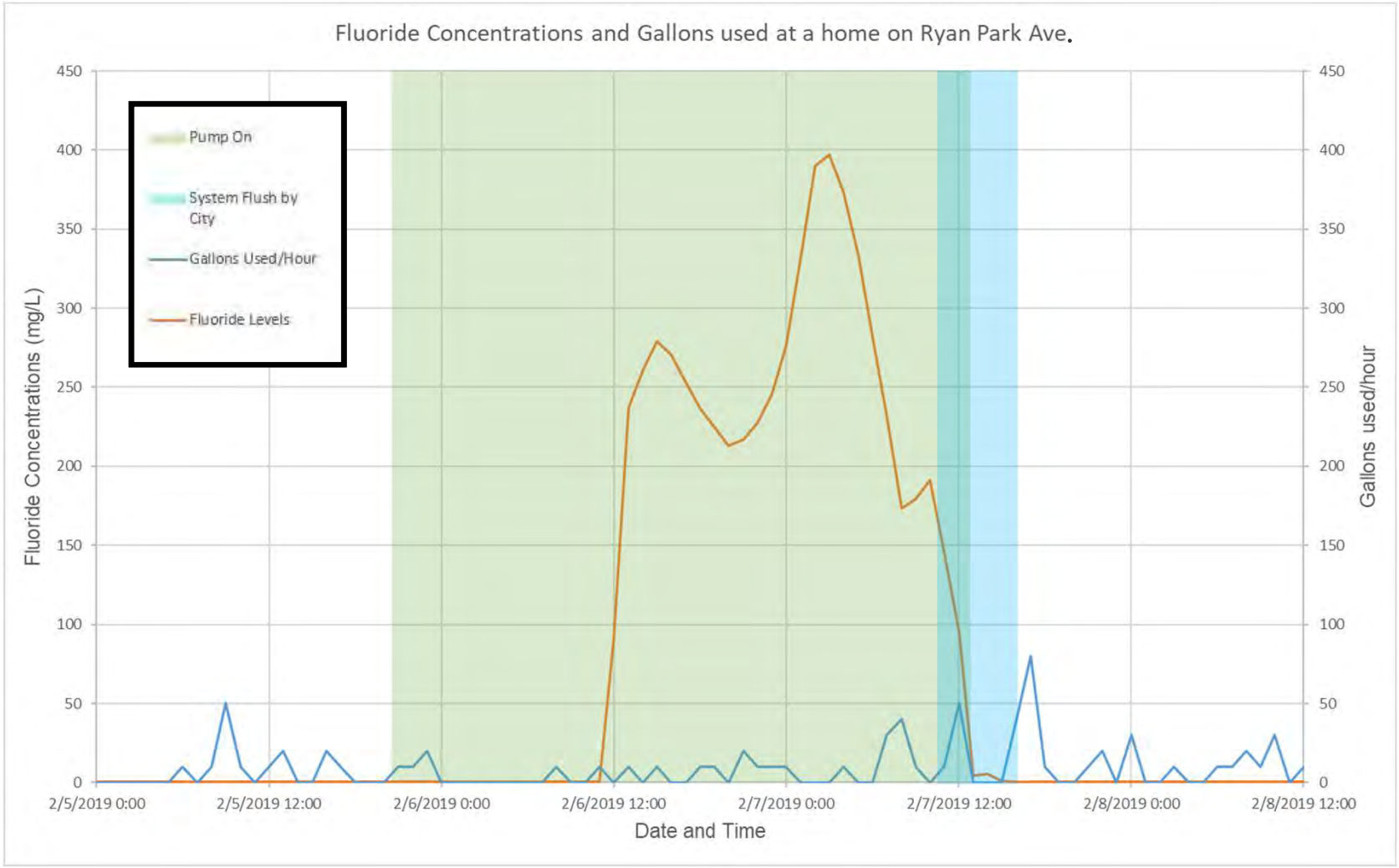
APPENDIX C

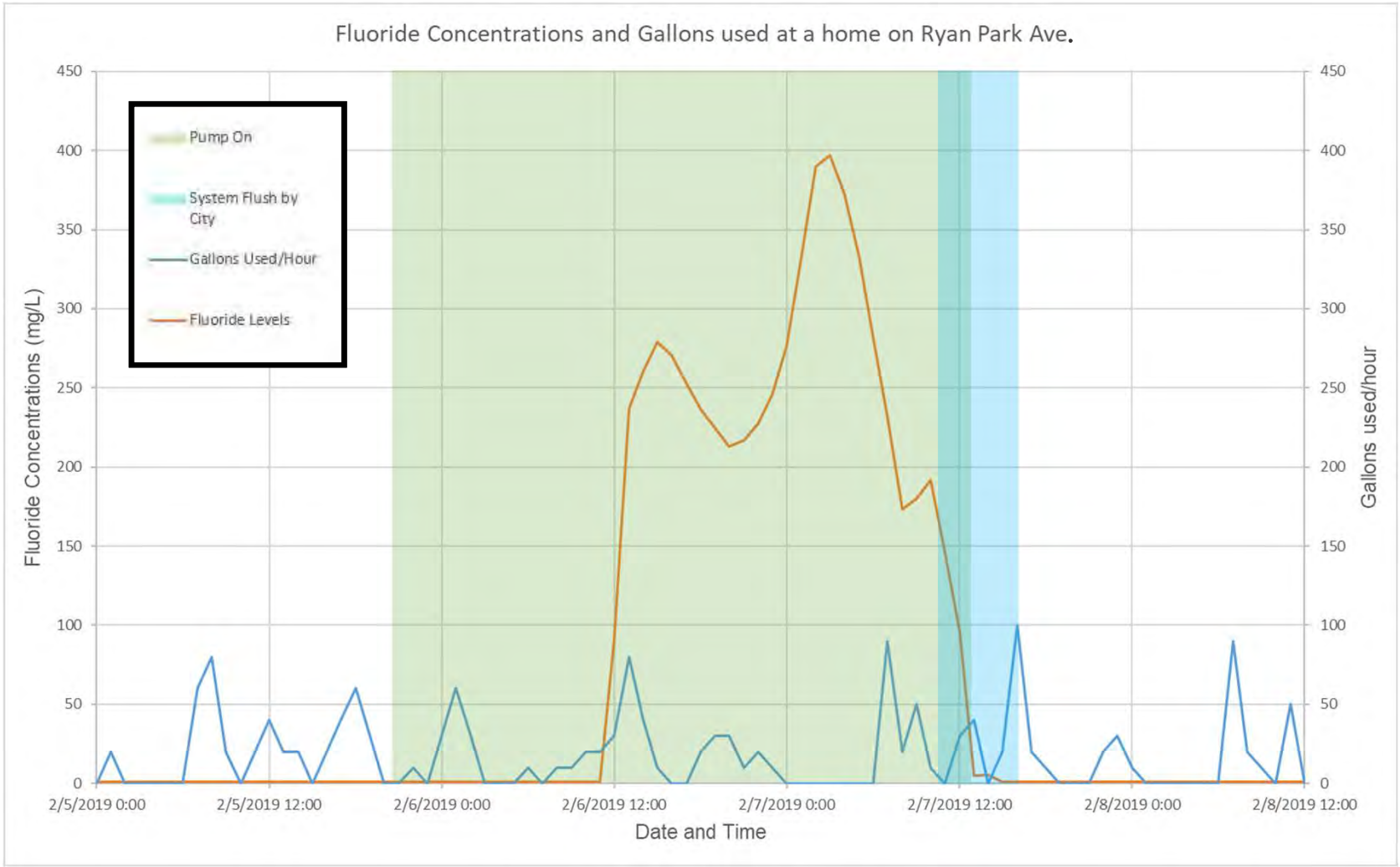
Customer Water Use Data

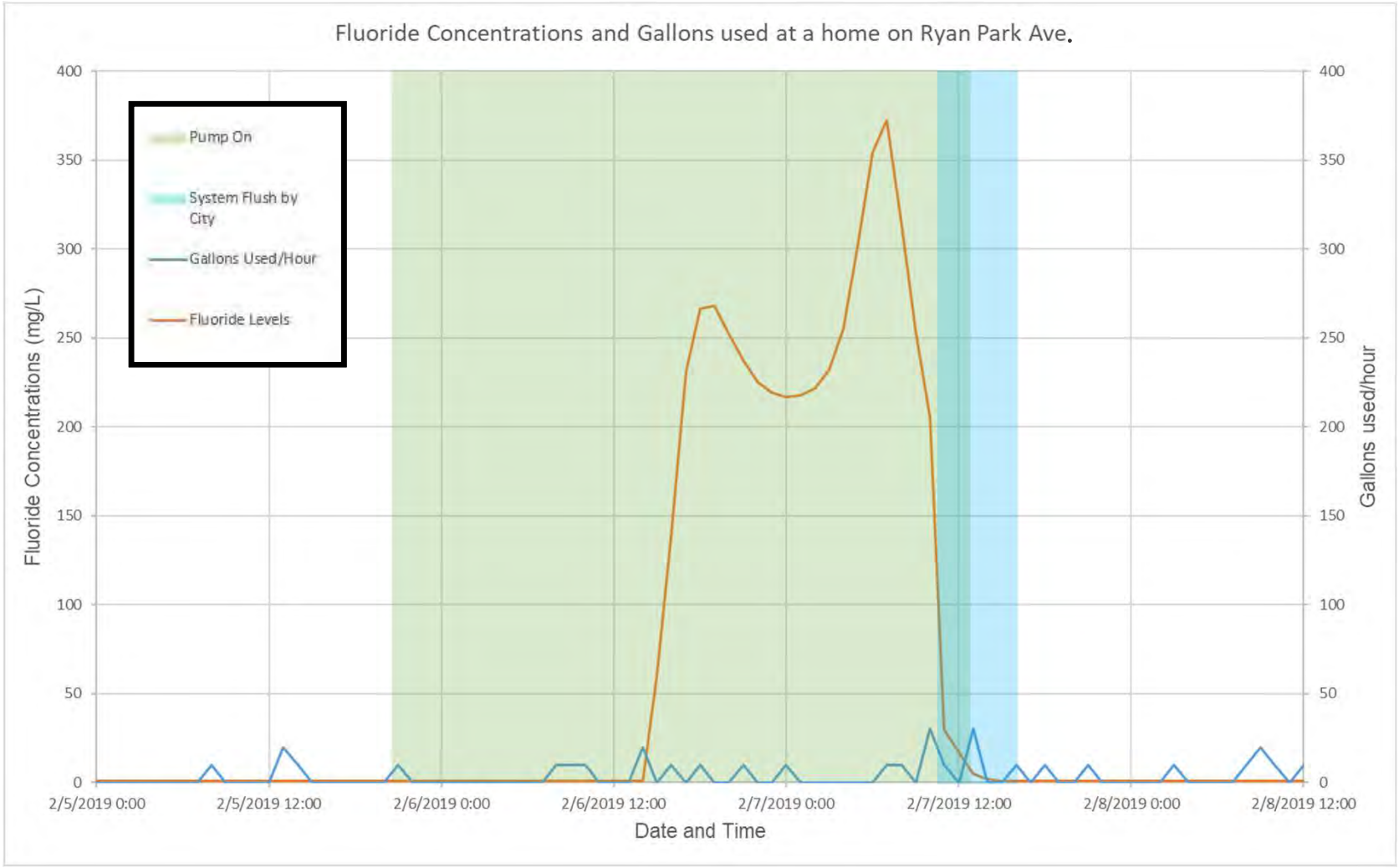

Fluoride Concentrations and Gallons used at a home on Ryan Park Ave.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
0
50
100
150
200
250
300
350
400
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00

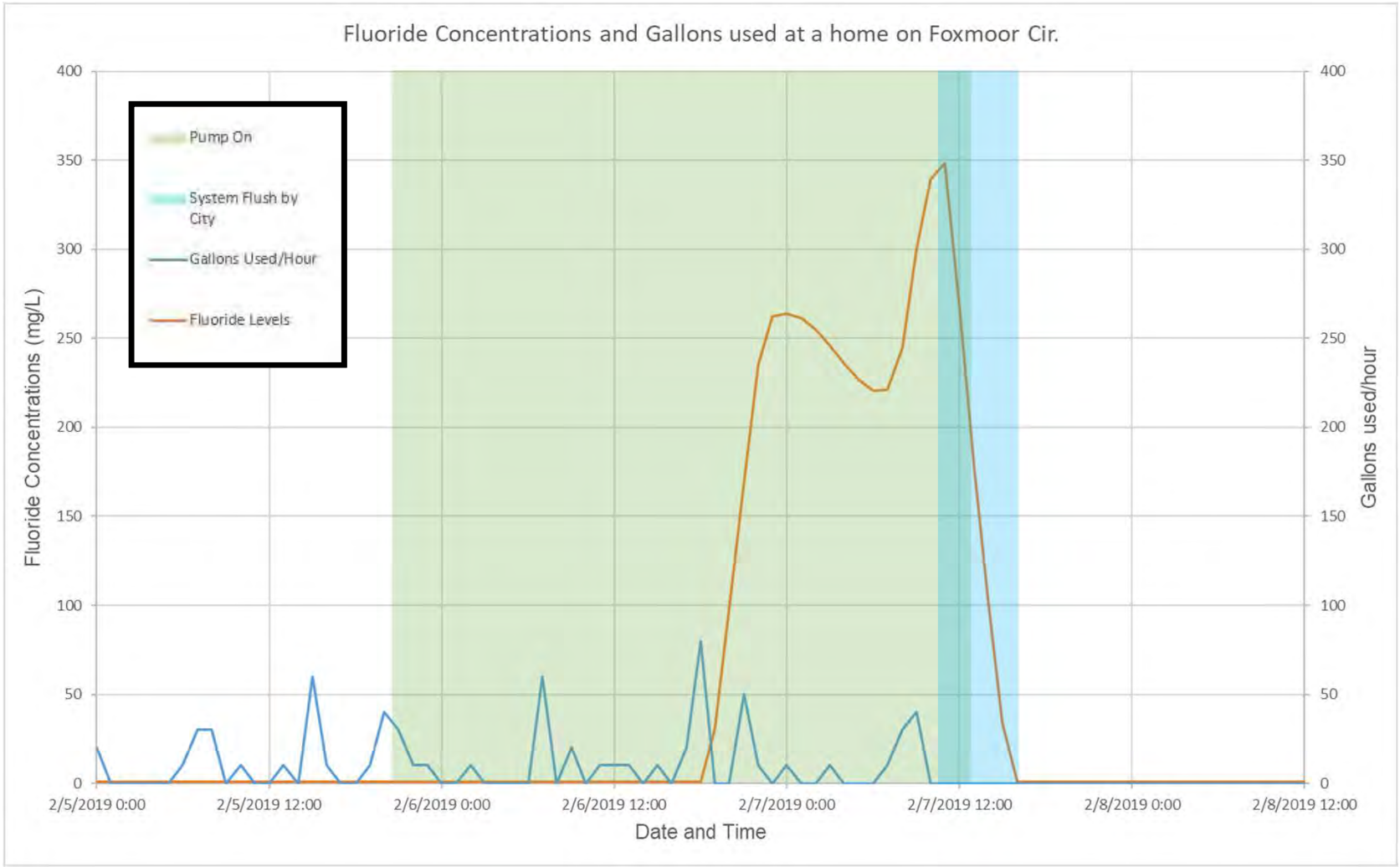

Fluoride Concentrations and Gallons used at a home on Ryan Park Ave.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
0
50
100
150
200
250
300
350
400
450
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00

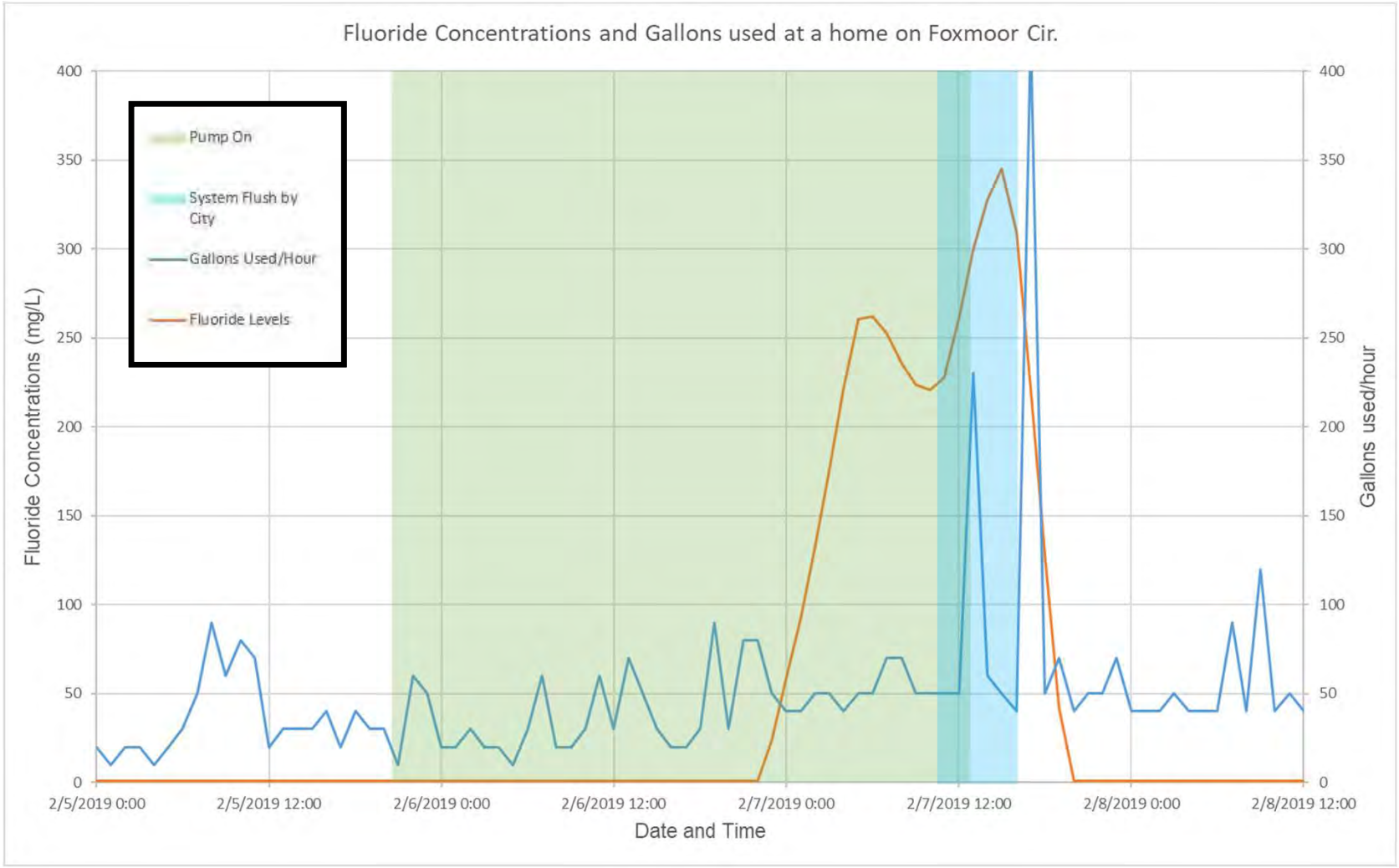

Fluoride Concentrations and Gallons used at a home on Ryan Park Ave.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
0
50
100
150
200
250
300
350
400
450
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00


Fluoride Concentrations and Gallons used at a home on Ryan Park Ave.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
450
400
350
300
250
200
150
100
50
0
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00


Fluoride Concentrations and Gallons used at a home on Ryan Park Ave.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
0
50
100
150
200
250
300
350
400
450
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00


Fluoride Concentrations and Gallons used at a home on Ryan Park Ave.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
400
350
300
250
200
150
100
50
0
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00


Fluoride Concentrations and Gallons used at a home on Foxmoor Cir.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
400
350
300
250
200
150
100
50
0
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00


Fluoride Concentrations and Gallons used at a home on Foxmoor Cir.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
0
50
100
150
200
250
300
350
400
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
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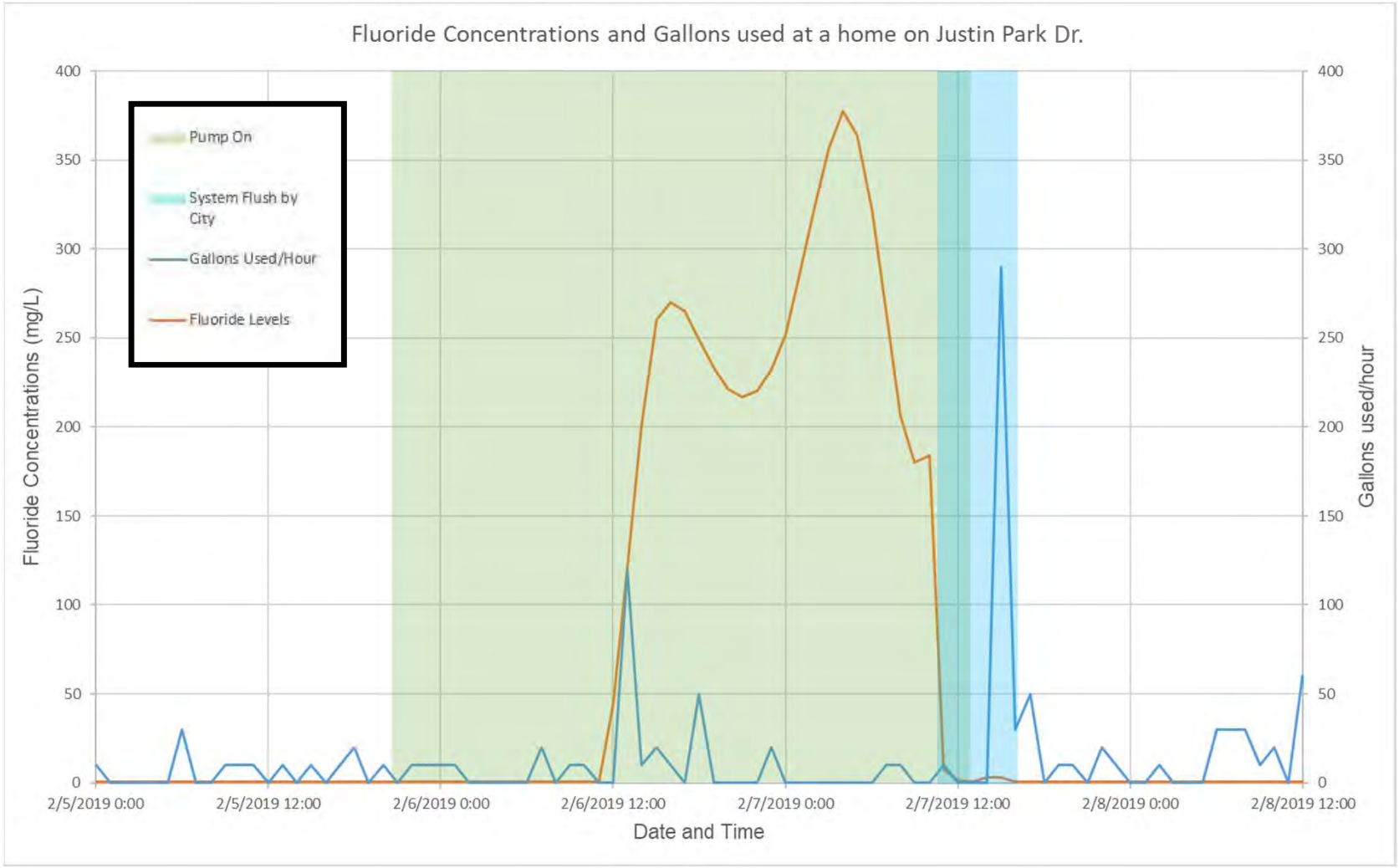
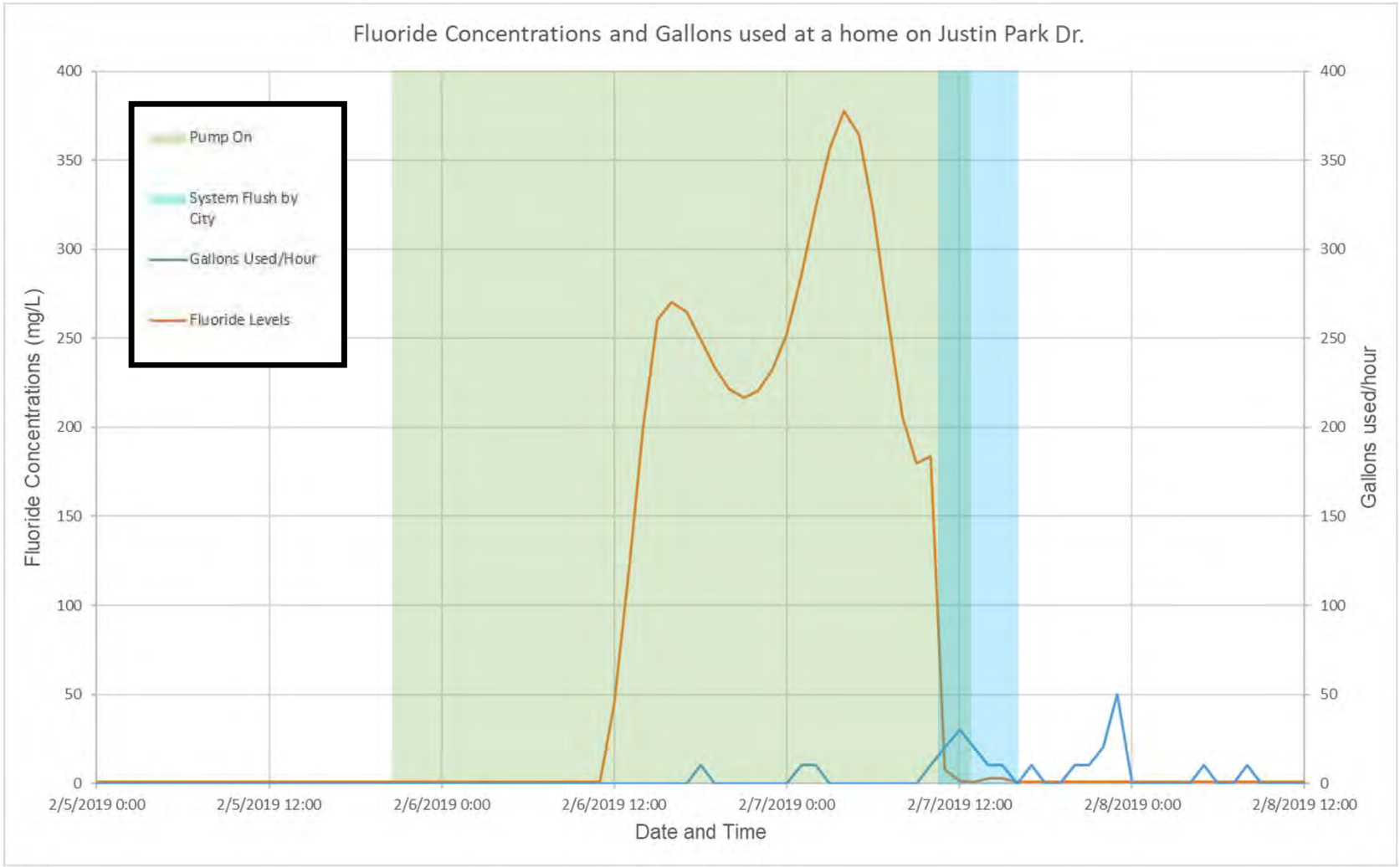
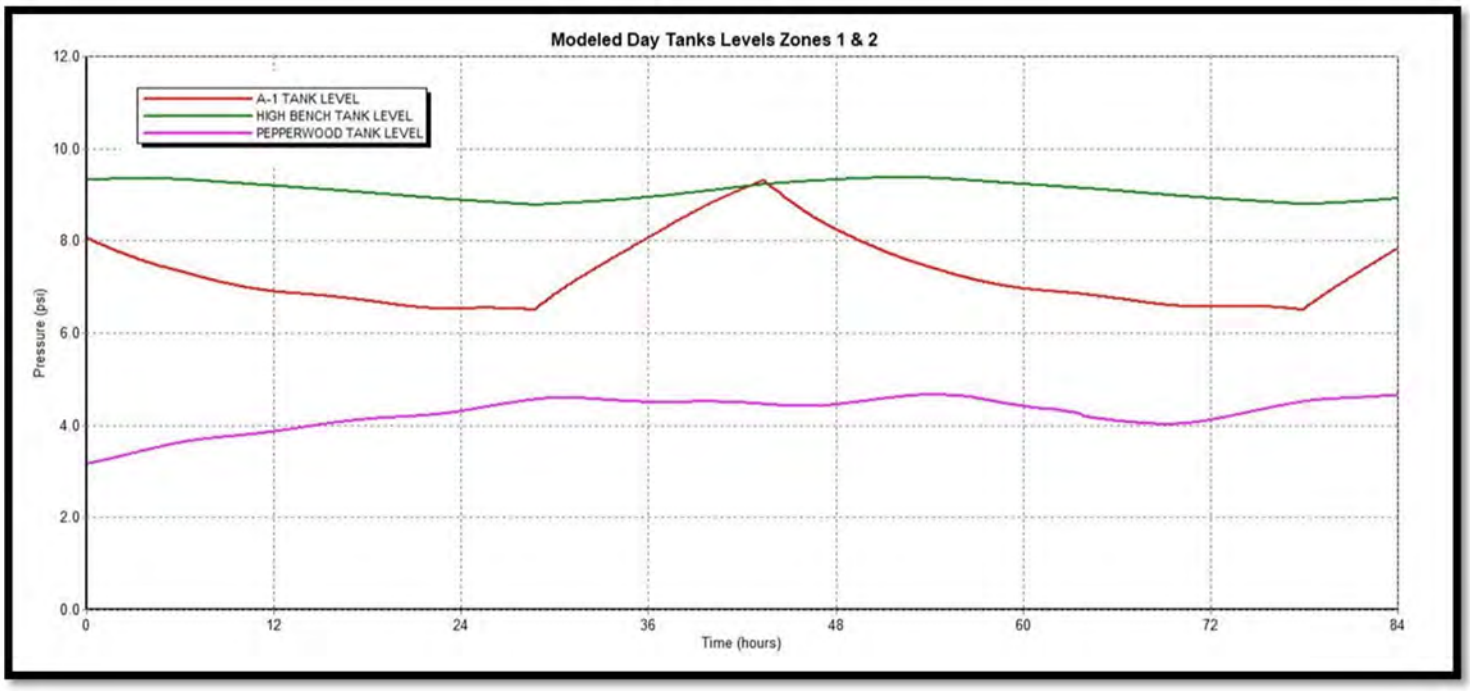
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00

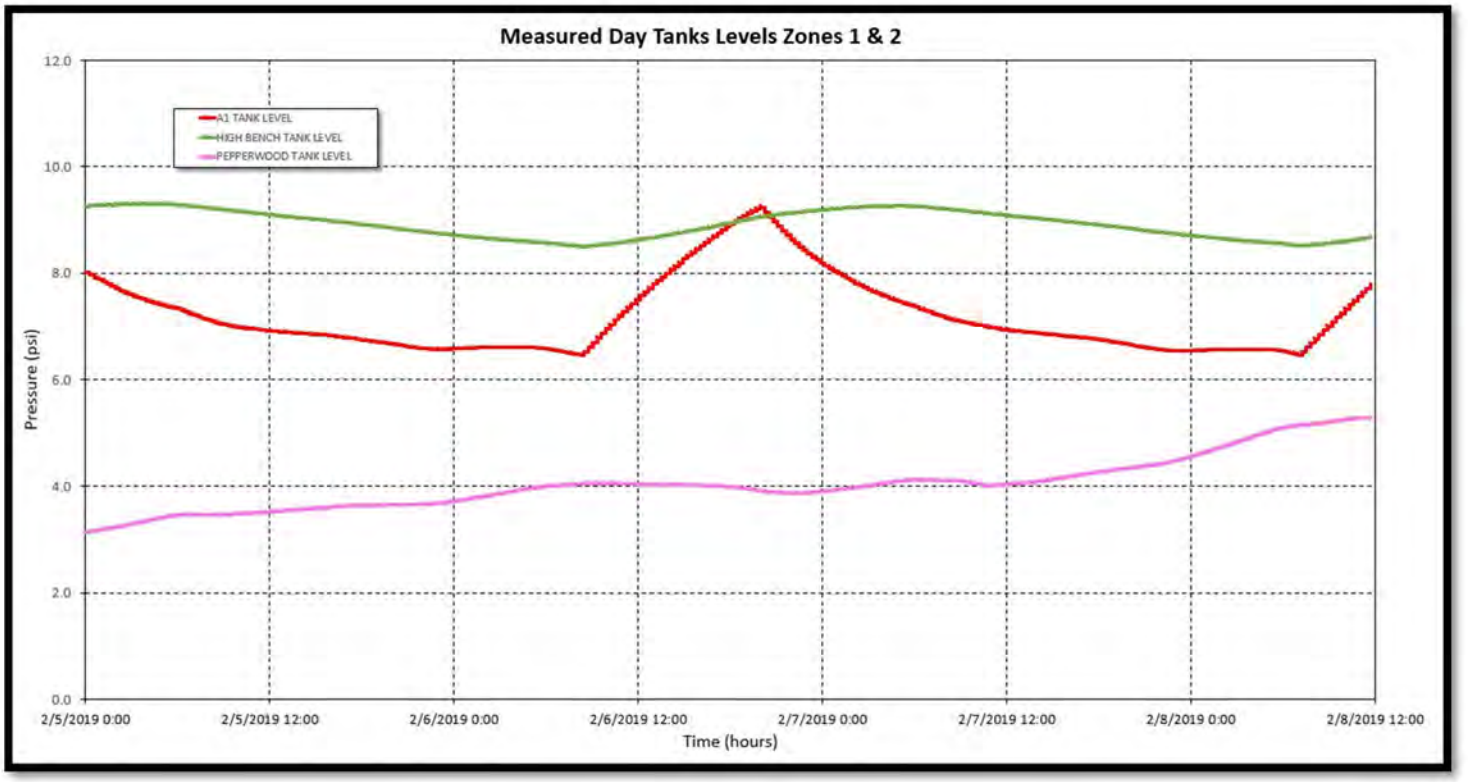

Fluoride Concentrations and Gallons used at a home on Justin Park Dr.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
400
350
300
250
200
150
100
50
0
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00

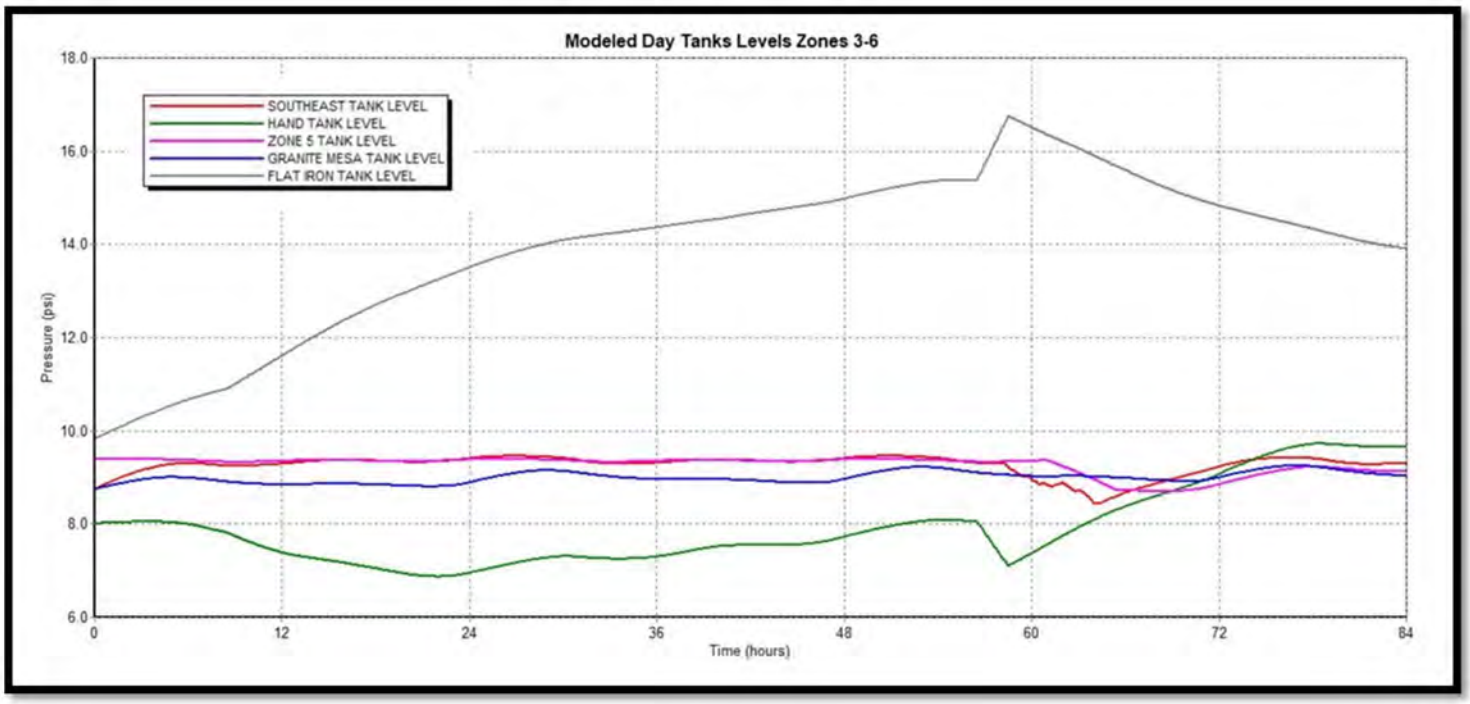

Fluoride Concentrations and Gallons used at a home on Justin Park Dr.
Pump On
System Flush by City
Gallons Used/Hour
Fluoride Levels
Fluoride Concentrations (mg/L)
Gallons used/hour
Date and Time
0
50
100
150
200
250
300
350
400
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00

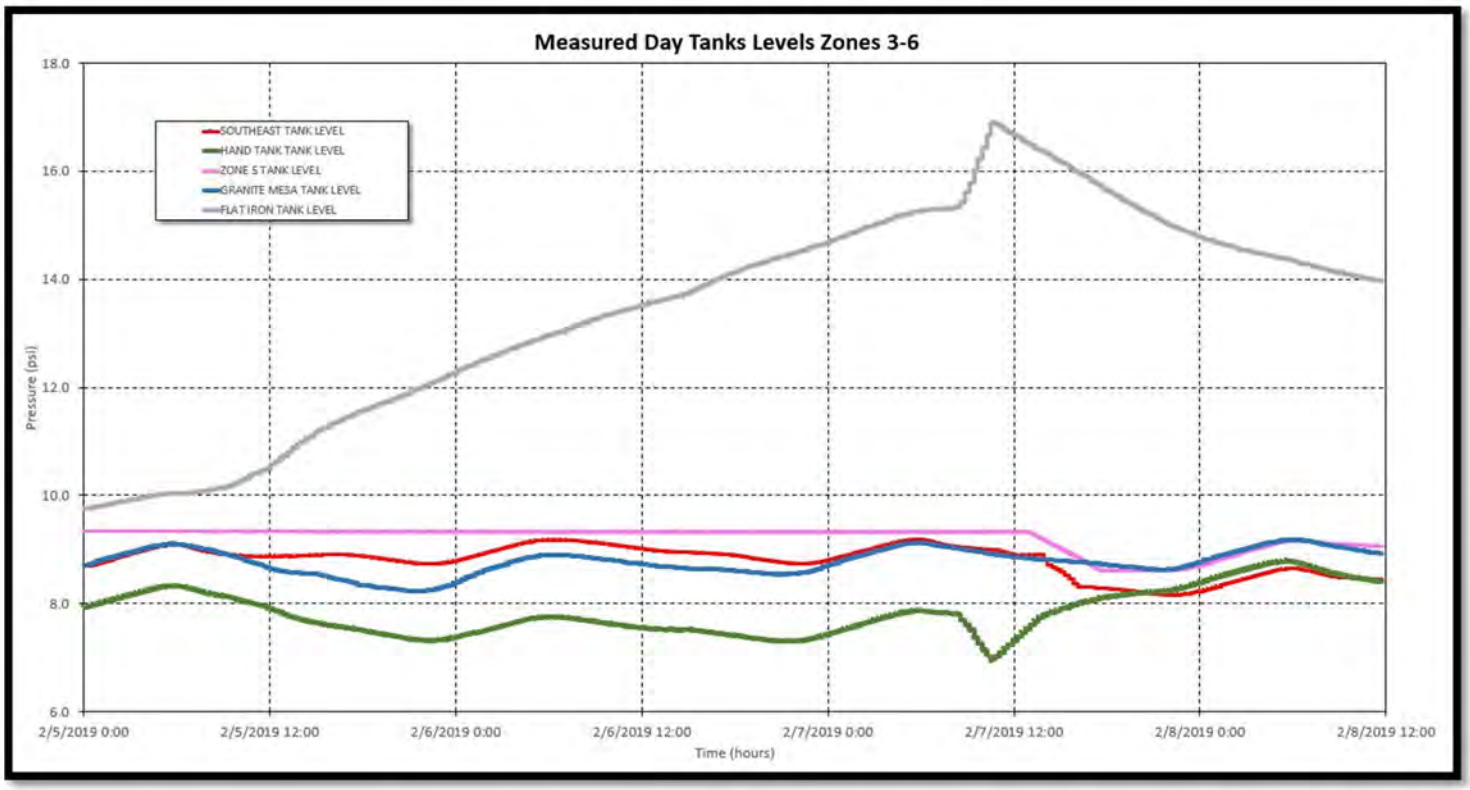
APPENDIX D

Calibration Results


Modeled Day Tanks Levels Zones 1 & 2
A-1 TANK LEVEL
HIGH BENCH TANK LEVEL
PEPPERWOOD TANK LEVEL
Pressure (psi)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
12
24
36
48
60
72
84
Time (hours)


Measured Day Tanks Levels Zones 1 & 2
A1 TANK LEVEL
HIGH BENCH TANK LEVEL
PEPPERWOOD TANK LEVEL
Pressure (psi)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00
Time (hours)


Modeled Day Tanks Levels Zones 3-6
SOUTHEAST TANK LEVEL
HAND TANK LEVEL
ZONE 5 TANK LEVEL
GRANITE MESA TANK LEVEL
FLAT IRON TANK LEVEL
Pressure (psi)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
0
12
24
36
48
60
72
84
Time (hours)


Measured Day Tanks Levels Zones 3-6
SOUTHEAST TANK LEVEL
HAND TANK TANK LEVEL
ZONE 5 TANK LEVEL
GRANITE MESA TANK LEVEL
FLAT IRON TANK LEVEL
Pressure (psi)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
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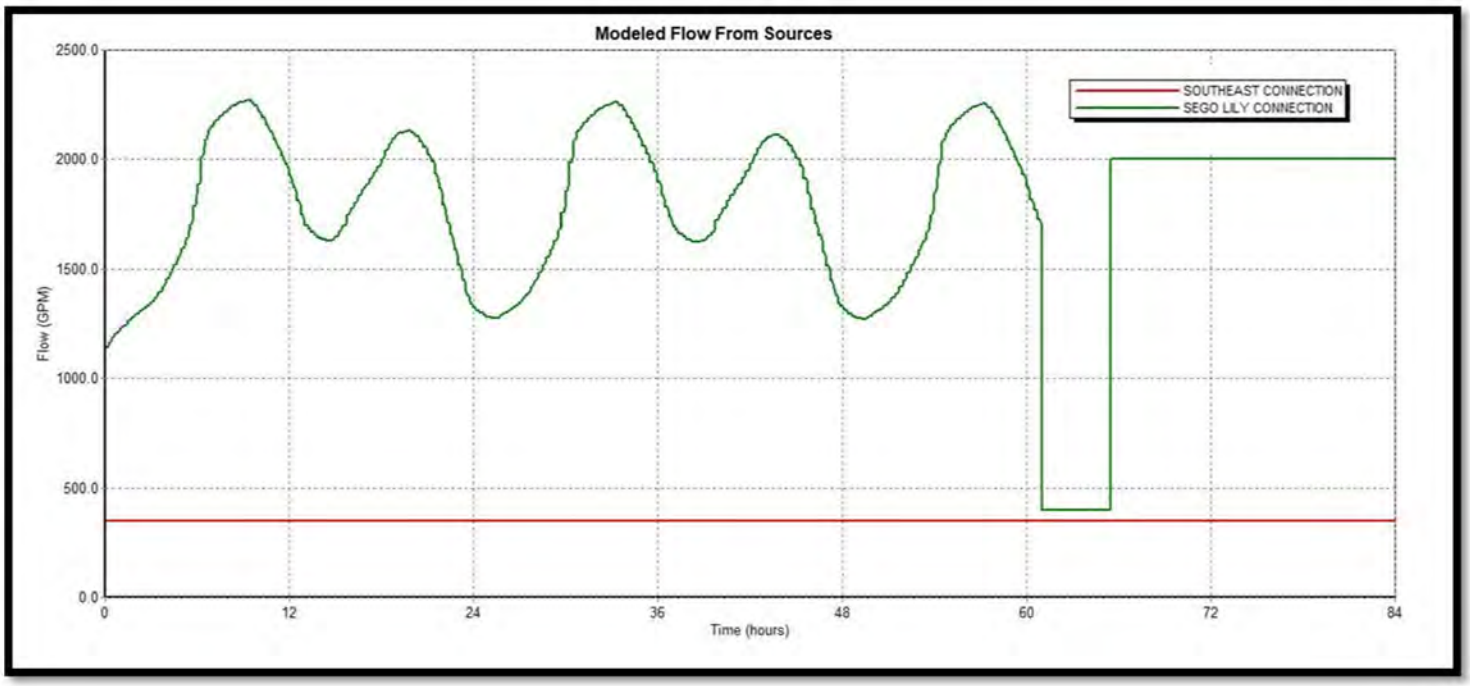
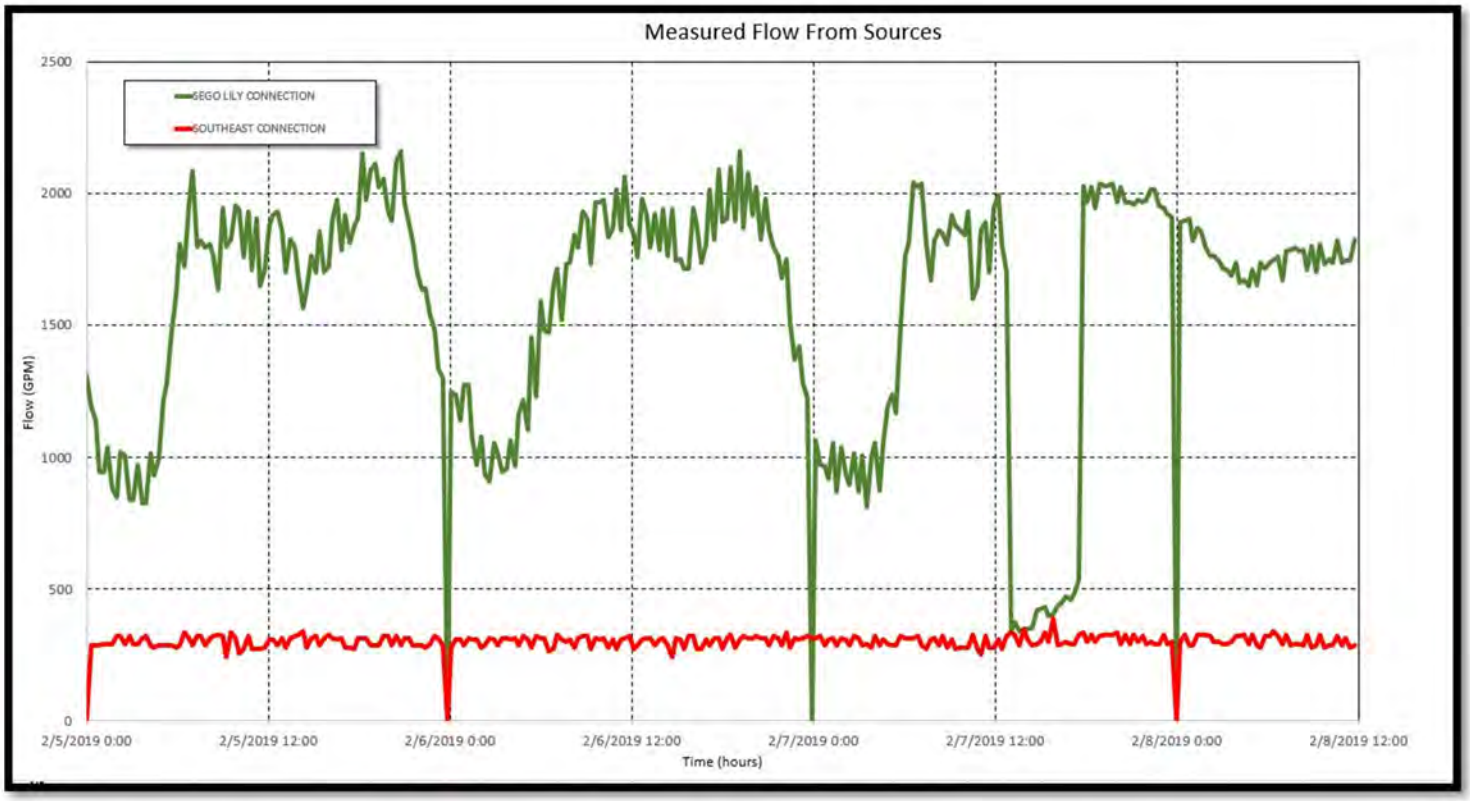
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00
Time (hours)


Modeled Flow From Sources
2500.0
2000.0
1500.0
1000.0
500.0
0.0
Flow (GPM)
0
12
24
36
48
60
72
84
Time (hours)
SOUTHEAST CONNECTION
SEGO LILY CONNECTION


Measured Flow From Sources
2500
2000
1500
1000
500
0
Flow (GPM)
2/5/2019 0:00
2/5/2019 12:00
2/6/2019 0:00
2/6/2019 12:00
2/7/2019 0:00
2/7/2019 12:00
2/8/2019 0:00
2/8/2019 12:00
Time (hours)
SEGO LILY CONNECTION
SOUTHEAST CONNECTION

APPENDIX E

Corrosion Control Study Plan

Post Fluoride-Overfeed Incident Corrosion Study
Sandy City Drinking Water System (#UTAH18028)
Last update: December 9, 2019

Sandy City, Utah, retained the services of CRS Engineers and Water Quality & Treatment Solutions, Inc. (WQTS) to assist in the preparation of a Corrosion Control Study (CCS) plan for the Sandy City drinking water system in response to item 8 of the *Issuance of Violations and Administrative Order, Sandy City Drinking Water System (#UTAH18028)* dated March 4, 2019. City, CRS, and WQTS staffs have participated in several meetings with the Division of Drinking Water (DDW) to discuss the study needs, and some additional data have already been collected from the system that helped inform the development of this Plan.

Background

The need for this corrosion control study was initiated by an over-fluoridation event at one of the City's groundwater wells (Paradise Valley Well) between February 5 and 7, 2019. A confluence of unforeseen and independent factors triggered the fluoride feed system to come on while the well was offline. By the time the system was turned off on February 7, the residents in the vicinity of the Well received water containing elevated levels of fluoride. More importantly, since hydrofluorosilicic acid is used as the fluoride supply chemical, the lack of dilution water from the Well resulted in the exposure of the water system pipes in the distribution system and the plumbing system in some of the homes in the impacted area to water with acidic conditions.

When the incident was discovered on February 7th, City staff shut down the fluoride feed and began flushing the high-fluoride water out of the system. Details about the City's post-incident actions are outlined in the report titled: "*Investigation of Paradise Valley Fluoridation Facility Malfunction*" dated November 2019, prepared by Hansen Allen & Luce (HAL). Beginning on February 7th, and continuing over the next three weeks, the City conducted fluoride sampling in the highest impacted area (Zone 1) to confirm that the excess fluoride has been flushed out of the drinking water system. However, the acidic conditions that prevailed during the event resulted in an increase in the levels of copper, lead, and other metals in the tap water in some of the affected residences. The potential long-term consequence of this short-term exposure is the primary concern of both the City and DDW, and hence the primary focus of this Study.

The objectives of this study are as follows:

1. Identify, quantify, and track any lingering effects of the event on the quality of the drinking water at the tap in the impacted area.
2. Ensure that the impacted residents are receiving safe drinking water at all times.
3. Identify any long-term mitigation measures that may be required to ensure the safety of the drinking water in the impacted area.

The City's Water System

The Sandy City Drinking Water System has water supplies made up of 16 groundwater wells owned and operated by the City, three wholesale connections with the Metropolitan Water District of Salt Lake & Sandy (MWDSLS), one emergency wholesale connection with the Jordan Valley Water Conservancy District, and one emergency connection with White City Water Improvement District. Figure 1 presents a map of the system facilities of MWDSLS. This map was provided by MWDSLS staff.

MWDSLS water supply is primarily made up of surface water supplies from Little Cottonwood Creek (LCC), Bell Canyon Creek, the Provo River diverted into the Salt Lake Aqueduct at Deer Creek Reservoir, and the Provo River diverted into the Provo River Aqueduct at the Murdock Diversion. Operational discretion by MWDSLS and other water supply agencies may divert Provo River water into the Salt Lake Aqueduct from the Olmstead Diversion via the Alpine/Jordan Aqueduct system. Also, the Provo River Aqueduct may receive water from Battle Creek and Grove Creek near Pleasant Grove. This description of the MWDSLS supply system was reviewed and approved by MWDSLS staff for accuracy.

Water delivered from MWDSLS to the City is primarily treated at the Little Cottonwood Water Treatment Plant (LCWTP). Treated water may be received from the Point of the Mountain Water Treatment Plant (POMWTP) if it is online. Two primary water sources are treated at the LCWTP: LCC or Provo River. Provo River water is the primary source of water treated at the POMWTP. The quality of LCC water is significantly different from that of Provo River water, which is why MWDSLS applies different chemical treatment to the different water sources to meet their treated water quality goals. Specifically, lime is added to LCC water to increase its alkalinity and hardness, while no lime addition is needed when treating Provo River water. Additional information on the chemical treatment strategy at the LCWTP will be included in the Study report.

Figure 2 presents a map of the City with the locations of the MWDSLS connections and wells shown. Treated water from MWDSLS is received at three entry points to the City's water system: 1) Point of the Mountain Aqueduct (POMA) meter vault at LCWTP, 2) POMA connection at Sego Lily Drive, and 3) POMA connection located north of Wasatch Boulevard along the proposed Highland Drive corridor (address coordinates are approximately 11650 South 2000 East). Most of the City's water is received from MWDSLS. For disinfection, MWDSLS uses chlorine gas at LCWTP and sodium hypochlorite at POMWTP. Additional detailed information on the disinfection types and strategies at MWDSLS will be included in the study report. In addition, detailed information on the pH control strategy at the treatment plants will be included in the Study report. During the summer months, the City augments MWDSLS water with groundwater from City-owned wells. While the wells are used for peaking purposes, each well is operational and can provide water supply at any time if needed.

Figure 1 – System Facilities of the Metropolitan Water District of Salt Lake & Sandy (Map provided by MWDSLS)

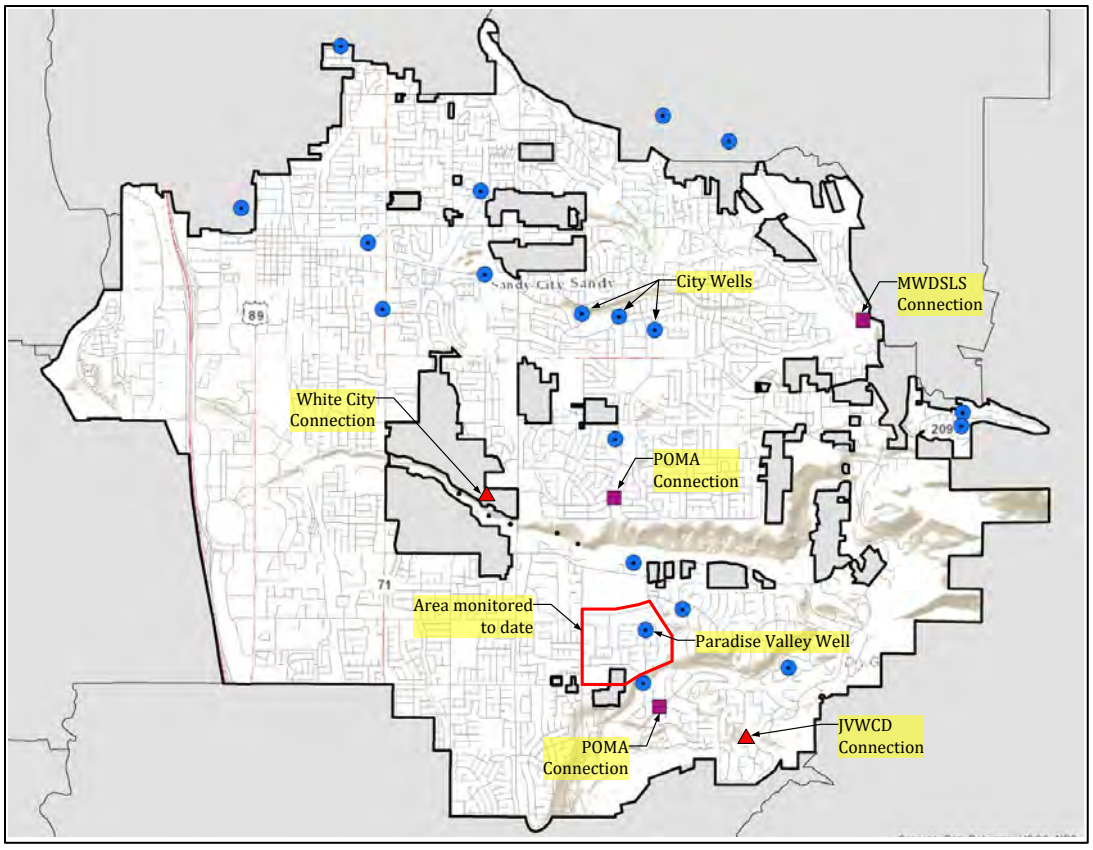


Figure 2 – Sandy City's Water System and Source Waters Entry Points and Area Monitored To-Date

Post-Incident Monitoring Results

On February 7th, upon discovering that hydrofluorosilicic acid had inadvertently entered the drinking water system for 43 hours, City staff conducted water quality monitoring in the impacted area while flushing the system to discharge the high-fluoride water from the system. Over the next three weeks, City staff worked with residents to collect tap water samples and analyze them for a broad range of constituents, primarily metals. During the first two weeks after February 7, City staff focused on an area in the system believed to be mostly affected, and this has been referred to as Monitoring Zone 1. On February 13th, after receiving an additional report of a health concern within Zone 1 and at the requirement of the Division of Drinking Water (DDW), the intensive monitoring was extended to a larger area, which was referred to as Monitoring Zone 2. For the purpose of this Plan, the monitoring results are separated between "inside" Zones 1 & 2, and "outside" Zones 1 & 2. The boundary labeled as "Area Monitored to Date" in Figure 2 represents Zones 1 & 2. This area encompasses 442 residences.

Figure 3 shows the fluoride levels measured in Zones 1 & 2 starting on February 7, 2019, and over the next three weeks. Specifically, on 2/7/2019, City staff collected six (6) samples from residences and a hydrant on Ryan Park Avenue, and one sample from the discharge pipe of the Paradise Valley Well. Figure 3 shows that the measured fluoride level on the morning of Thursday (2/7/19) was as high as 152 mg/L. As City staff flushed the system and worked with residents to flush their homes, the measured fluoride level decreased by the afternoon to about 1.1 mg/L. Follow-up sampling and field analysis on the next day (2/8/2019) showed that the fluoride was well below the drinking water limit of 4 mg/L (Right side chart in Figure 3). Over the subsequent three weeks, the fluoride levels were mostly between 0.5 mg/L and 1.0 mg/L, with few exceptions as shown in the chart on the right side of Figure 3.

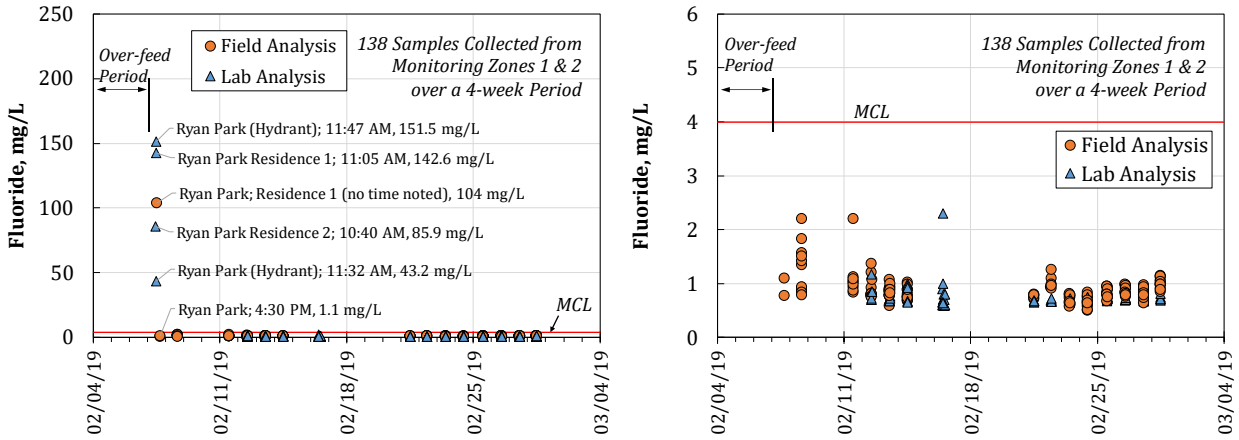


Figure 3 – Tap Water Fluoride Levels in the days after the Over-Feed Incident [Left Side Chart shows the full range, while the Right Side Chart Shows the Levels after 2/7/2019]

Unfortunately, high doses of hydrofluorosilicic acid can significantly lower the pH of the water. Samples collected by City staff on the morning of 2/7/2019 were analyzed by MWDSLS laboratory and were determined to have a pH value between 3.8 and 5.9. After flushing, the pH increased to approximately 7.0 as measured by City staff on 2/13/2019. Exposing the distribution system and home plumbing to low pH water can result in the release of metals and other constituents into the water. Metal surfaces in home plumbing systems include galvanized iron pipes, copper pipes, and lead-containing materials, such as tin/lead solder used prior to its ban in 1986, and brass fixtures which have varying levels of lead content. Iron surfaces in the distribution system may also concentrate various metals, such as arsenic, simply by adsorbing it out of the water. Even if the water generally contained very low levels of arsenic, a significant accumulation of arsenic on the surface of iron pipes may occur over the years. If acidic conditions cause the dissolution of iron, it may release with it some of the arsenic accumulated on the iron surface. In addition, a number of trace metals that may be present in low concentrations in the water entering the distribution system may precipitate very slowly in a system and accumulate in pipes and reservoirs. Two examples are manganese and aluminum. Manganese is commonly present in groundwater sources at low levels that are far below its secondary limit of 0.05 mg/L. However, as manganese is exposed to chlorine

added for disinfection, it can slowly oxidize and precipitate as manganese dioxide, MnO_2. Similarly, aluminum may be present in groundwater, but is also present in low concentration in the effluent of surface water treatment plants that use aluminum-based coagulants. These trace levels of aluminum may also slowly precipitate in the system. When many of these precipitates are exposed to low-pH water, they can rapidly re-dissolve in the water at levels well above their regulatory limits.

Table 1 presents the list of metals and inorganics analyzed in water samples collected from residences inside Zones 1 & 2 after the incident. A total of 32 constituents were monitored, with different constituents collected from different numbers of homes ranging from four (4) homes per constituent to 403 homes (out of a total of 442). The third column in each section of Table 1 shows the total number of samples analyzed for each constituent. For example, for arsenic, a total of 37 samples were collected from 7 homes. On the other hand, for lead, 556 samples were collected from 403 homes.

Table 1 – List of Metals & Inorganics Sampled from Residences inside Zones 1 & 2 and Analyzed after the Incident

Analyte	No. of Homes	No. of Samples
Aluminum	4	25
Antimony	5	29
Arsenic	7	37
Barium	4	38
Beryllium	4	24
Boron	4	24
Cadmium	7	27
Calcium	4	38
Chromium	6	26
Cobalt	4	36
Copper	403	556
Iron	4	38
Lead	403	556
Lithium	4	37
Magnesium	4	38
Manganese	6	39

Analyte	No. of Homes	No. of Samples
Mercury	4	35
Molybdenum	6	40
Nickel	6	40
Phosphorus, as P	4	37
Potassium	4	39
Selenium	7	41
Silica, (as SiO_2)	4	38
Silver	6	30
Sodium	4	38
Strontium	4	38
Thallium	5	24
Tin	4	24
Titanium	4	24
Uranium	4	38
Vanadium	4	25
Zinc	4	26

In addition, starting on February 16, 2019, water quality samples were collected from several locations outside Zones 1 and 2 and analyzed for various metals and inorganics. Table 2 presents a summary of the list of parameters analyzed, the number of addresses from which each parameter was analyzed, and the total number of samples analyzed for that parameter. For example, a total of 1,724 lead and copper samples were collected from 1,692 addresses, which included residences, schools, daycare centers, and other buildings.

Table 2 – List of Metals & Inorganics Sampled from Residences, Schools, and other Buildings Outside Zones 1 & 2 and Analyzed after the Incident

Analyte	No. of Addresses	No. of Samples	Analyte	No. of Addresses	No. of Samples
Aluminum	3	3	Mercury	3	3
Antimony	6	6	Molybdenum	5	5
Arsenic	7	7	Nickel	5	5
Barium	3	3	pH	3	3
Beryllium	4	4	Phosphorus as P	3	3
Boron	3	3	Potassium	3	3
Cadmium	5	5	Selenium	7	7
Calcium	3	3	Silica, (as SiO_2)	3	3
Chromium	5	5	Silver	5	5
Cobalt	4	4	Sodium	3	3
Copper	1,692	1,724	Strontium	3	3
Fluoride	3	3	Thallium	4	4
Iron	3	3	Tin	3	3
Lead	1,692	1,724	Titanium	3	3
Lithium	3	3	Uranium	4	4
Magnesium	3	3	Vanadium	4	4
Manganese	4	4	Zinc	3	3

Figures 4 through 7 show the profiles of iron, arsenic, manganese, and aluminum, respectively, measured inside and outside of monitoring zones 1 & 2 on and after February 7, 2019. Unfortunately, the acidic conditions that reached the system during the overfeed incident released significant levels of iron, arsenic, manganese, and aluminum from the system such that their levels exceeded their drinking water limits on February 7th as shown in Figures 4 through 7 (limits are shown as red horizontal lines). The good news is that their levels quickly decreased to below their regulatory limits within one week and have remained at those levels since.

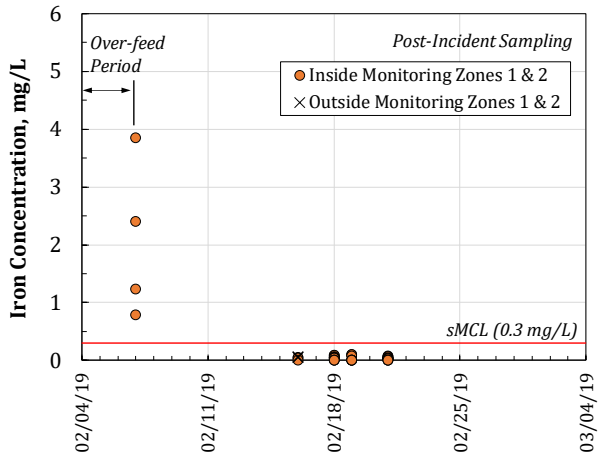


Figure 4 – Tap Water Iron Levels in the days after the Over-Feed Incident

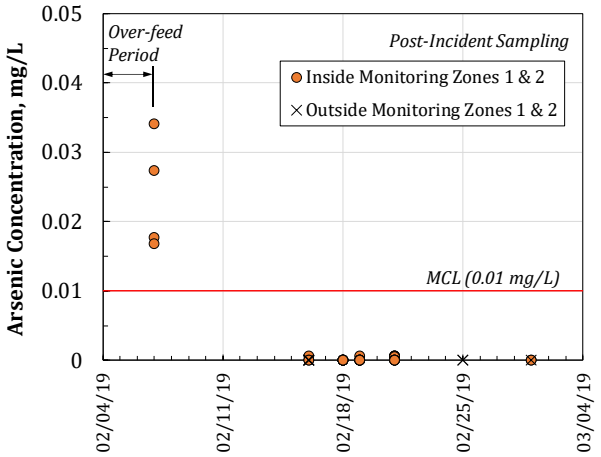


Figure 5 –Tap Water Arsenic Levels in the days after the Over-Feed Incident

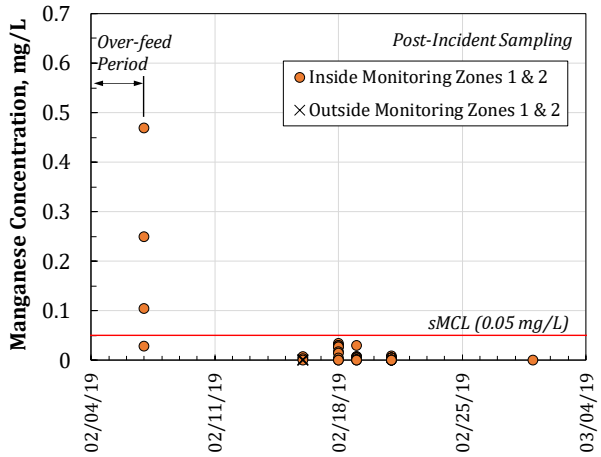


Figure 6 – Tap Water Manganese Levels in the days after the Over-Feed Incident

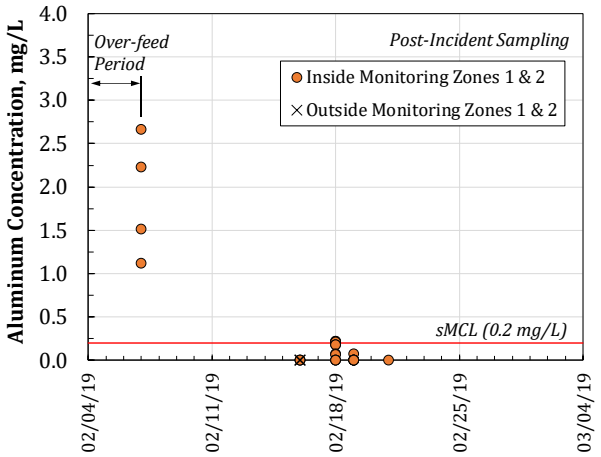


Figure 7 –Tap Water Alumium Levels in the days after the Over-Feed Incident

The two metals of particular concern are lead and copper because they are the main components of home plumbing. Figures 8 and 9 present the post-incident monitoring results for both metals starting on February 7, 2019. Each figure has two charts: The left-side chart has an arithmetic vertical scale to show all the results, while the right-side chart uses a log-scale for the vertical scale in order to show the details of the levels measured after February 11, 2019. Similar to the other metals profiled in Figures 3 through 7, the levels were quite high at the homes sampled on February 7th but decreased significantly over the next several days. However, as shown by the right-side charts in Figures 8 and 9, the lead and copper levels were still present in some tap water samples at elevated levels well after the low-pH water was flushed out of the system.

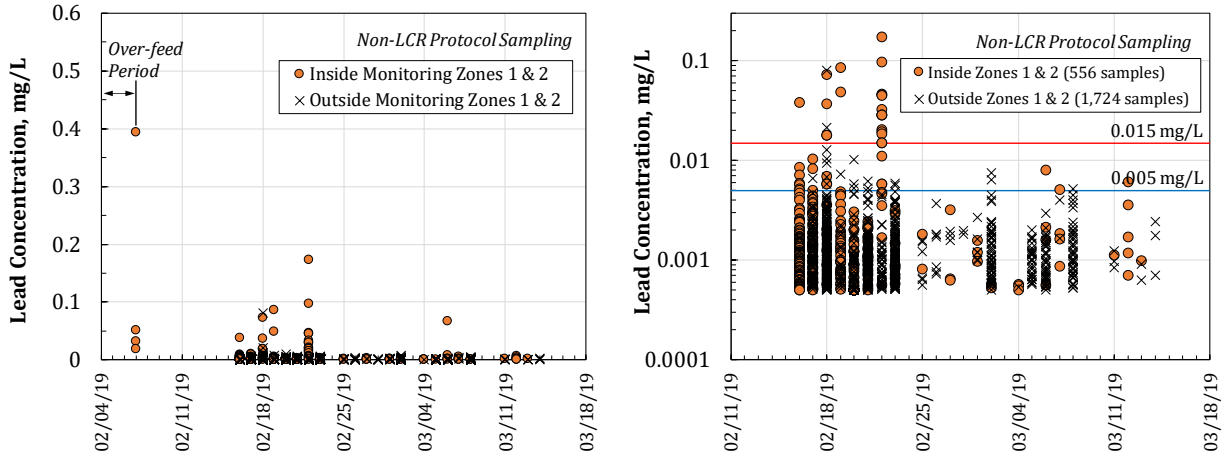


Figure 8 – Tap Water Lead Levels in the days after the Over-Feed Incident

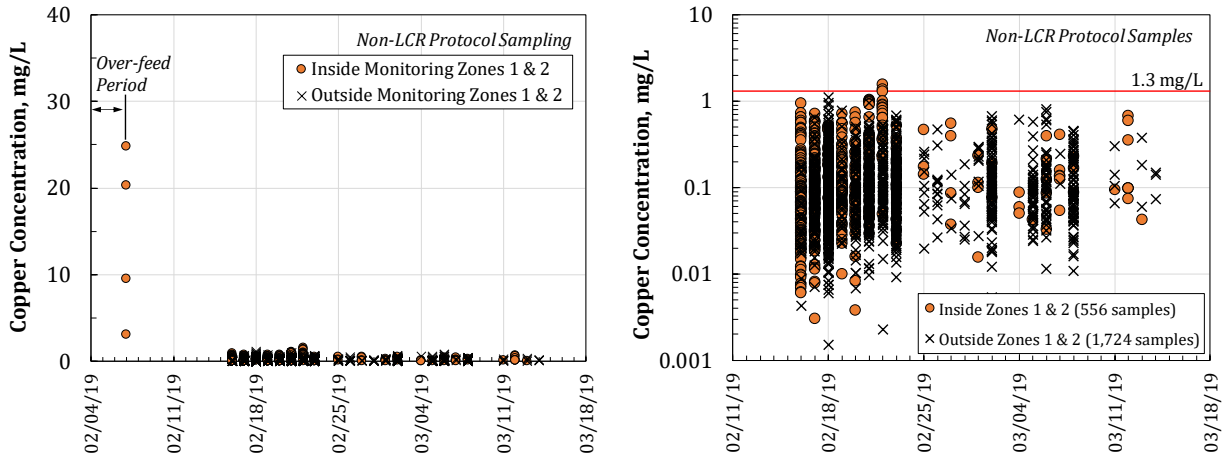


Figure 9 –Tap Water Copper Levels in the days after the Over-Feed Incident

To take a closer look at the lead and copper levels in the system after the incident, the results shown in Figures 8 and 9 are presented in Figure 10 as occurrence distribution profiles. The profiles show that 4.7% of lead samples inside zones 1 and 2 exceeded the Action Level (AL) of 0.015 mg/L and 1.25% of copper samples inside zones 1 and 2 exceeded the copper AL of 1.3 mg/L. However, more importantly, the profiles shown in Figure 10 show that there was a slightly higher occurrence of elevated levels of lead and copper inside monitoring zones 1 & 2 compared to outside those zones. This suggests that there may be a lingering effect of the incident on copper and lead containing materials in some of the impacted homes. This will be the primary focus of this plan.

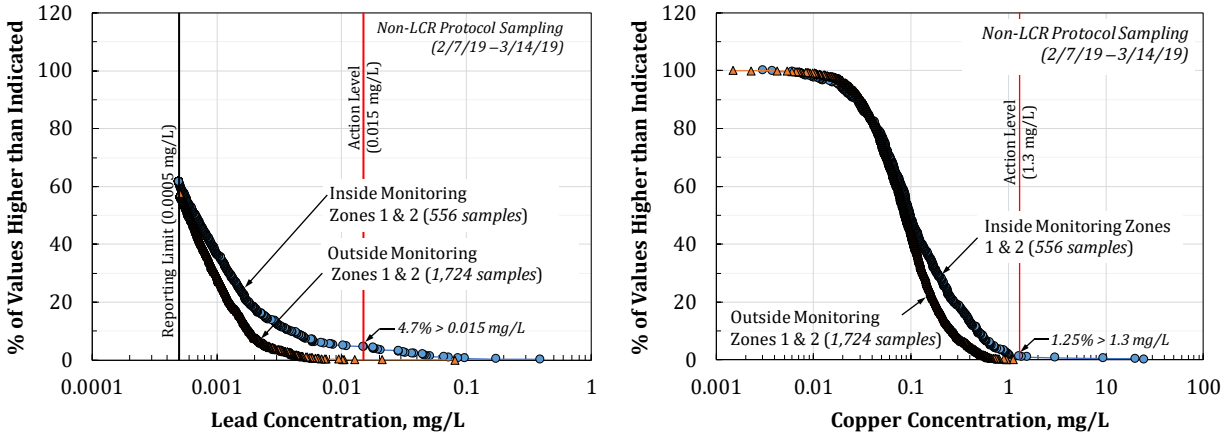


Figure 10 – Results of non-LCR protocol Lead and Copper Monitoring between February 7 and March 14, 2019, with the Samples Segregated between those Collected from Inside and those Collected from Outside Monitoring Zones 1 & 2

LCR Monitoring Results

It is important to note that the data presented in Figures 8 through 10 are for lead and copper samples collected from homes during normal water-use conditions, and not using the stagnation protocol prescribed under the Lead-and-Copper Rule (LCR). This was necessary, appropriate, and approved by the State during the days following the incident as the City was trying to rapidly assess the impact of the fluoride overfeed condition on lead and copper release into the system.

Since the issuance of the Administrative Order under which this corrosion control study is being conducted, the City began quarterly monitoring of lead and copper in accordance with the LCR protocol. In accordance with DDW requirements, the City collected samples from at least 60 homes with at least 30 homes being inside monitoring zones 1 and 2. The first round was conducted during the 2nd quarter of 2019, and the second round was conducted during the 3rd quarter of 2019. The results of these two rounds are presented and analyzed herein.

Figure 11 shows a map of the City and the locations of the 60 sampling sites from which the samples were collected during the 2nd quarter of 2019. A total of 38 of the 60 sites were inside monitoring zones 1 & 2 (clustered red dots in Figure 11), while the remaining 22 sites were in other parts of the

City. It is important to note that only eight of the 38 sampled homes inside zones 1 & 2 were Tier 1 sites as defined by the LCR (i.e., single family homes built between 1982 and 1986). The remaining homes were either built before 1982 (14 homes) or after 1986 (16 homes). It is also important to note that, while most homes sampled contained copper plumbing, it is not certain that all did.

During the monitoring in the 3rd quarter 2019, 32 of the 38 homes inside zones 1 and 2 monitored during the 2nd quarter remained in the program. The six homes that dropped out were replaced with five new residences from inside the area for a total 37 homes sampled inside zones 1 and 2 during the 2nd quarterly monitoring period.

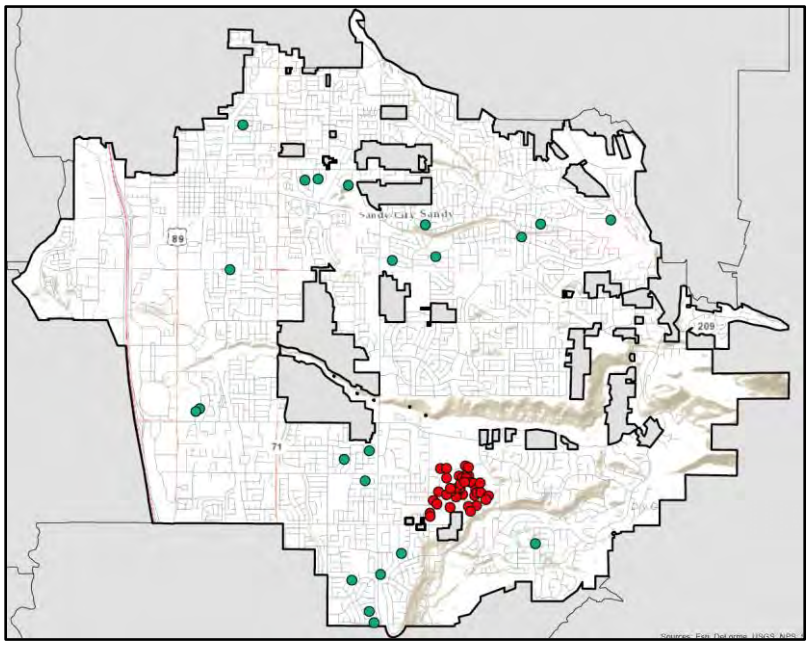


Figure 11 – Locations of All LCR Sampling Sites (2nd Quarter 2019)
(Red Clustered Circles are Inside Monitoring Zones 1 & 2, while Remaining Green Circles are Outside Monitoring Zones 1 & 2)

The results of the first round of lead and copper quarterly sampling (2nd quarter 2019) are presented in Figure 12. The data are presented as a cumulative distribution profile vs. lead concentration. This type of plot more clearly identifies the range and distribution of the results, in addition to the 90th percentile value of interest to the LCR compliance determination. The left-side plot is for lead while the right-side plot is for copper. Each plot shows the "% of Values less than Indicated" as a function of the indicated "Lead Concentration". For example, the copper plot shows that 60% of the samples contained copper less than approximately 0.16 mg/L. The red dots marked in Figures 12 and 13 represent the 90th percentile lead and copper levels in the 60 samples collected. The analysis shows that the 90th percentile lead was only 0.003 mg/L compared to a lead AL of 0.015 mg/L, while the 90th percentile copper level was 0.428 mg/L compared to a copper AL of 1.3 mg/L. These values are considered very low by the LCR compliance standard and typically indicate that a system has good

corrosion control. Only two samples contained lead above the AL of 0.015 mg/L, and no copper samples contained copper above the AL of 1.3 mg/L.

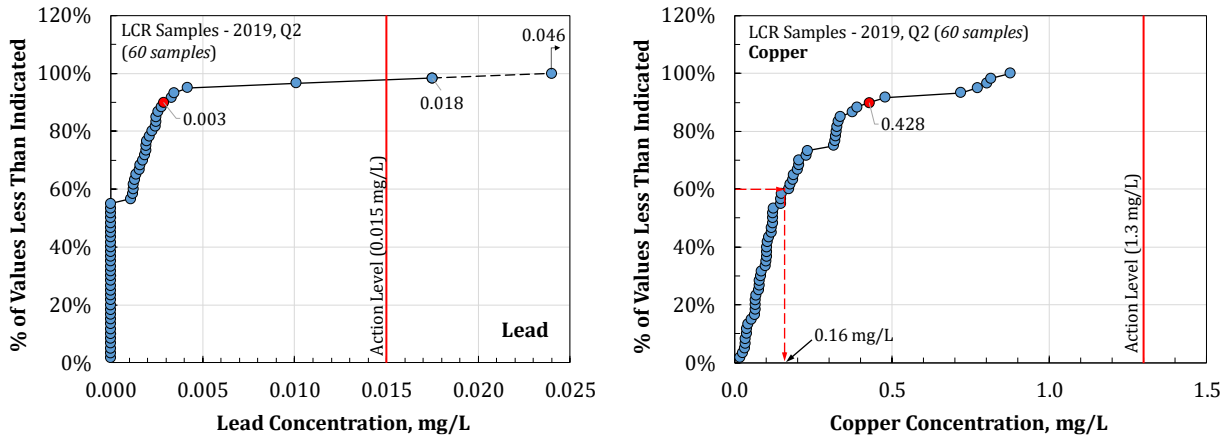


Figure 12 – Results of Lead and Copper Monitoring Under the LCR (2nd Quarter, 2019)
[tagged red dots represent the 90th percentile values]

Similar plots of the second round of quarterly sampling (3rd quarter, 2019) are presented in Figure 13. Similar to the results of the 2nd quarterly sampling, the 90th percentile lead level was 0.004 mg/L and the 90th percentile copper level was 0.383 mg/L, both of which are well below the respective AL values.

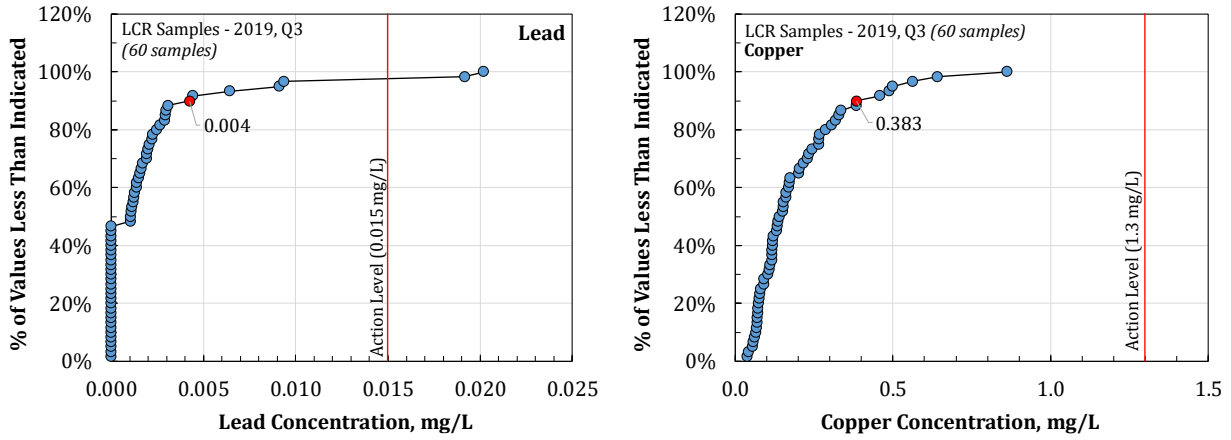


Figure 13 – Results of Lead and Copper Monitoring Under the LCR (3rd Quarter, 2019)
[tagged red dots represent the 90th percentile values]

However, since the data collected in each quarter are a mix of samples collected from inside and outside monitoring zones 1 and 2, they were segregated, and each batch was analyzed using the same cumulative distribution approach. The results are presented in Figures 14 and 15 for the 2nd quarter and 3rd quarter, 2019, respectively. The blue circles in each graph represent the distribution of the lead and copper levels in the samples collected from inside zones 1 and 2, while the orange triangles represent the distribution of the lead and copper levels in the samples collected from outside zones 1 and 2.

The analysis shows that the three highest lead levels measured during the 2nd quarter (0.01, 0.018, and 0.046 mg/L) were all from samples collected from inside monitoring zones 1 and 2. The distribution of the copper results also shows a shift to higher levels in the samples collected from inside zones 1 and 2 compared to the distribution of the copper results in the samples collected from outside zones 1 and 2. This initial analysis suggests that a few months after the incident there may have been a lingering effect of the low-pH conditions that existed during the incident on the leaching of copper and lead from home plumbing.

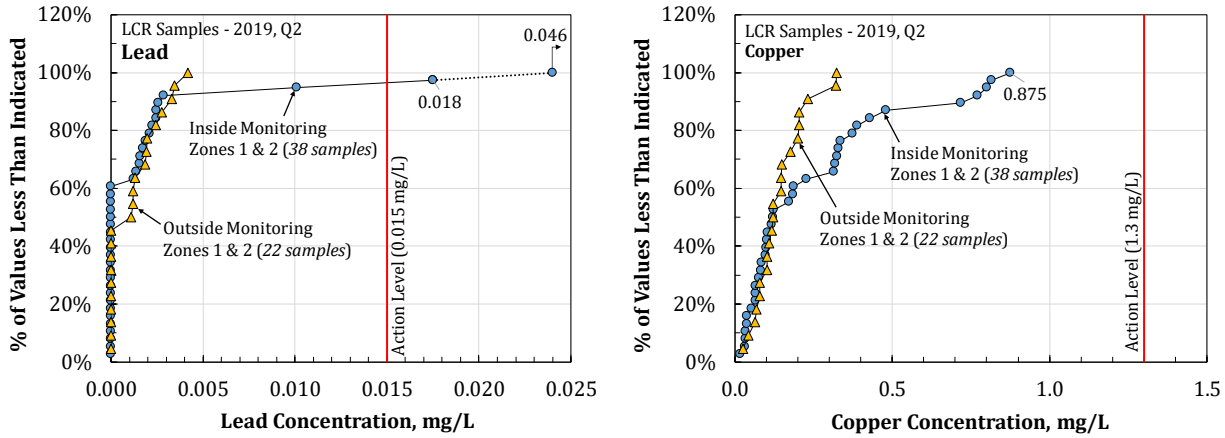


Figure 14 – Results of Lead and Copper Monitoring Under the LCR (2nd Quarter, 2019) Separated between the Samples Collected from Inside Monitoring Zones 1 & 2 and those Collected from Outside Monitoring Zones 1 & 2

Nonetheless, it is worth noting that no copper level was above the AL of 1.3 mg/L, and only two of 38 samples contained lead above the AL of 0.015 mg/L. This is highly encouraging as it suggests that the effect of the low-pH event may be minor. This observation is supported by the results from the 3rd quarter 2019 monitoring (Figure 15), which show that the difference between the distribution of the results from inside zones 1 and 2 and that of the results from outside zones 1 and 2 has already diminished compared to the 2nd quarter 2019 results.

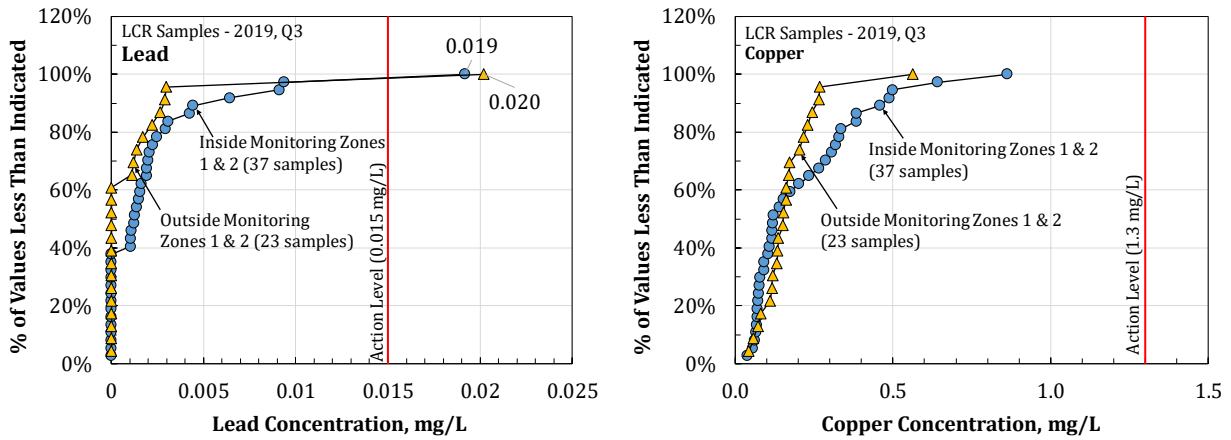


Figure 15 – Results of Lead and Copper Monitoring Under the LCR (3rd Quarter, 2019) Separated between the Samples Collected from <u>Inside</u> Monitoring Zones 1 & 2 and those Collected from <u>Outside</u> Monitoring Zones 1 & 2

It is noted that the relatively low lead and copper levels measured in the LCR monitoring results presented above are not unique in that similar distributions were present in past LCR results. The LCR monitoring results from 2007, 2010, 2013, and 2016 for lead and copper are presented in Figure 16. The distributions show that past 90th percentile lead levels ranged from 0.0032 mg/L to 0.0049 mg/L, and the 90th percentile copper levels ranged from 0.169 mg/L to 0.33 mg/L. These past results suggest that none of the water sources served into the system during those sampling periods had any corrosive quality of concern.

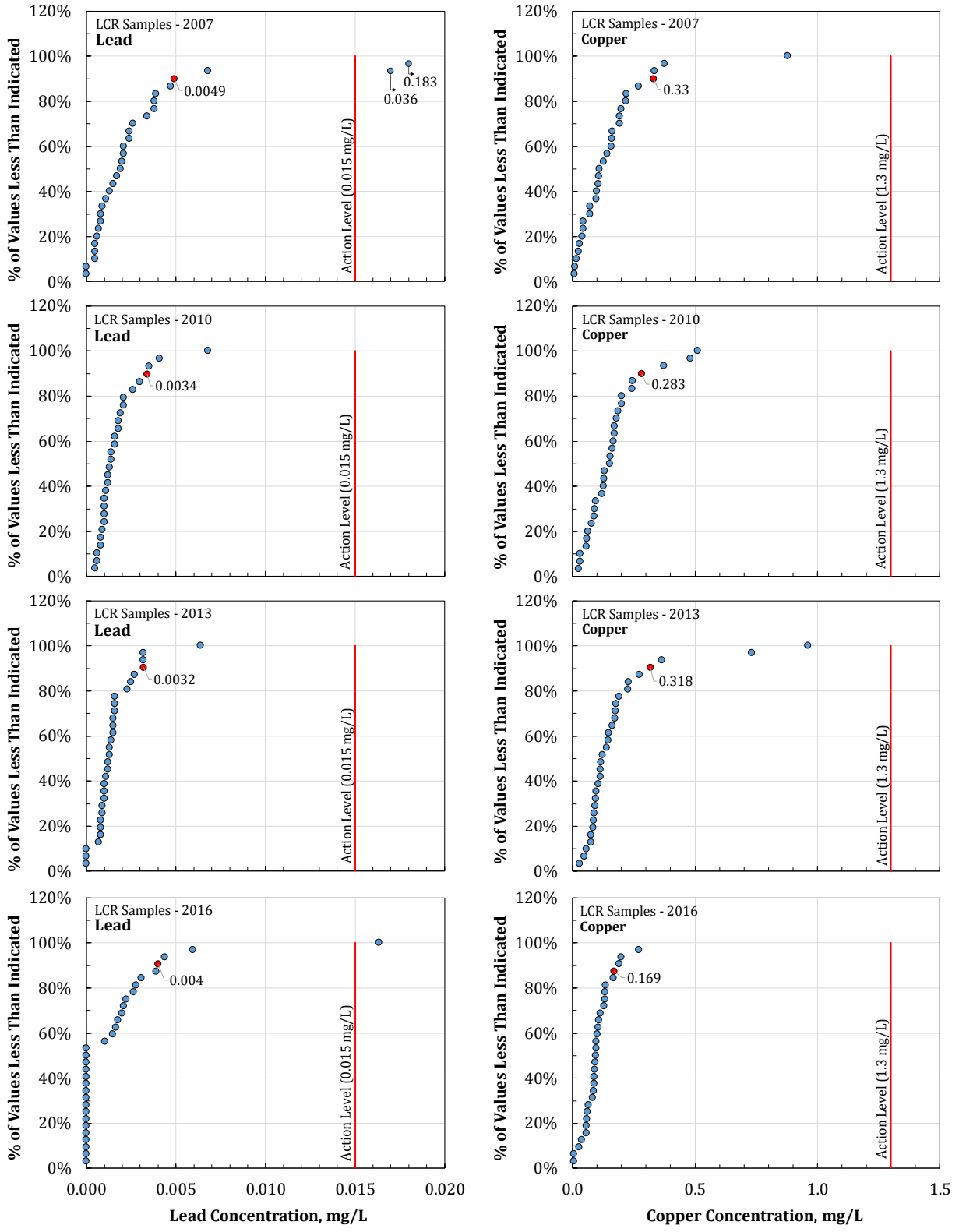


Figure 16 – Full Results of Lead and Copper Monitoring Under the LCR (2007 – 2016)
[tagged red dots represent the 90th percentile values]

Recommended Action Plan

Based on the analysis presented earlier, the following observations are made:

1. The acidic conditions that prevailed during the fluoride overfeed incident did cause a short-term release of metals into the tap water at some of the impacted homes.
2. The metals release decreased dramatically for most constituents but remained noticeable for lead and copper levels approximately three to four months after the incident.
3. By the LCR standards, the lead and copper levels are relatively low, even inside monitoring zones 1 and 2.

While the monitoring results to-date are encouraging and suggest that the system is in recovery mode, a focused monitoring of the homes in the impacted area for a period of one (1) year is still recommended out of an abundance of caution to confirm that the residents that experienced the event are receiving good quality drinking water at their taps. In addition, it is noted that the LCR focuses on homes with copper plumbing. However, this incident may have also affected homes with galvanized iron plumbing, and it is important that they be equally evaluated.

Monitoring Area

Thus far, City staff has focused on what is referred to herein as monitoring zones 1 and 2 to represent the area to have been potentially impacted by the event. However, over the last few months, hydraulic modeling has been conducted by the consulting engineering firm of Hansen Allen and Luce (HAL) and was used to clearly delineate the area that would have received the low-pH water. Details of the hydraulic water quality modeling can be found in a technical report prepared by HAL titled: "*Investigation of Paradise Valley Fluoridation Facility Malfunction*" and dated November 2019. The report has been transmitted to DDW separately. Based on this hydraulic model, Figure 17 presents the specific boundary of the area that would have received water containing fluoride above 4 mg/L. This is a conservative fluoride level in that it encompasses an area larger than the one that experienced acidic conditions of concern. Nonetheless, the technical team recommends that, moving forward, this area be defined as the most likely area of influence and that the monitoring effort under this Plan be focused on this area alone. To be specific, this area includes 270 homes that draw water from mains in the following streets:

- Justin Park Dr. west of the Paradise Valley Well connection
- Ryan Park Avenue
- Foxmoor Drive
- Foxmoor Circle
- Foxmoor Place
- Barrett Park Drive (west of Wyngate Lane)
- Brandon Park Dr. (north of Crescent View Dr.)
- Brandon Park Way
- Brandon Park Place
- S 1835 East
- 10980 South, between 2000 East (to the east) and S 1700 East (to the west)
- Ellen Way
- Mary Drive
- Susan Drive
- S. Susan Drive
- E. 11170 South
- Teakwood Drive
- Crescent View Dr. (east of S. 1700 East)
- Jane Circle
- S 1740 East

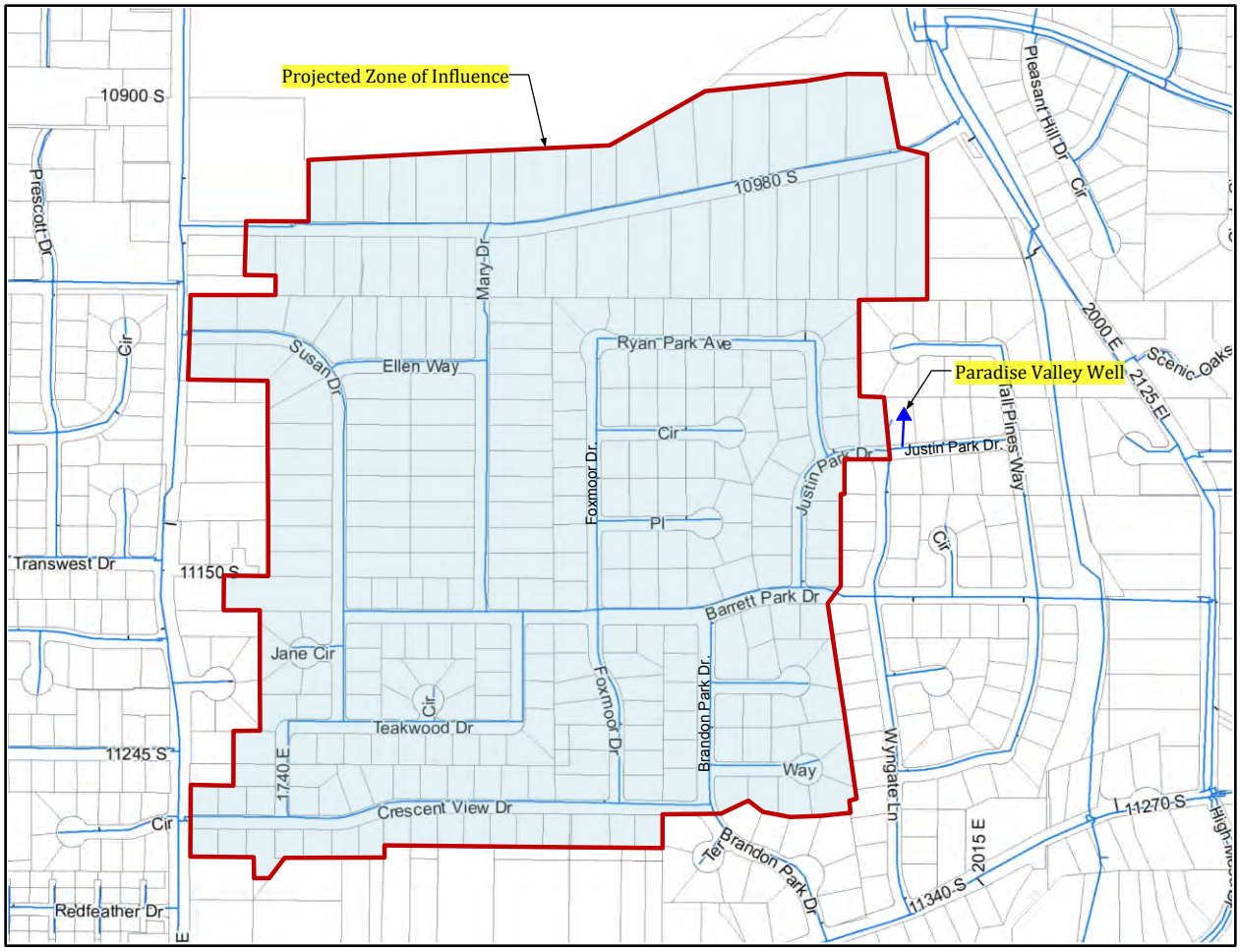


Figure 17 – Projected Zone of Influence based on Hydraulic Modeling of Fluoride Migration through the System (Boundary represents projected fluoride levels above 4 mg/L)

Recommended Monitoring

The technical team recommends that the City implement a focused monitoring program of as many homes as possible inside the zone of influence for a period of one (1) year in accordance with the following plan:

1. Send a letter to each of the 270 residents in the area of influence and inform them of the City's desire to partner with them to track the levels of metals in their tap water, and to solicit their agreement to participate in the monitoring program.

2. For those residents who agree to participate in the program, obtain information from the residents about their service line (SL) and internal plumbing materials, and then categorize them in one of the following:
    a. homes with copper SL or plumbing

b. homes with galvanized iron SL or plumbing
c. homes with non-metal SL or plumbing
d. homes with unidentified or mixed SL and plumbing materials

3. For any participating residence with copper plumbing, gather relevant information related to the age of the plumbing material for the sole purpose of determining whether or not it may contain lead/tin solder.

4. Based on the SL or plumbing material in each residence, plan on monitoring the tap water in that residence for relevant metals. The proposed metals to be monitored are listed in Table 3 below. All samples will be collected after overnight stagnation of no less than six hours. When a residence is being sampled, two consecutive 1-L samples will be collected, and each sample will be labeled as Sample 1 or Sample 2. Depending on the plumbing material, each sample will be analyzed for the specific set of constituents shown in Table 3. For example, for residences with a copper SL and containing copper plumbing, the two samples will be analyzed for lead and copper. However, for residences containing galvanized SL and galvanized plumbing, the samples will be analyzed for lead, iron, and arsenic, but not for copper. Homes with unknown or mixed SL or plumbing will be analyzed for all four constituents listed in Table 3.

Table 3 – List of Metals to be Monitored in both Samples based on House Service Line or Plumbing Material

	Metals to Monitor			
Plumbing Type	**Lead**	**Copper**	**Iron**	**Arsenic**
Copper SL and Plumbing	✓	✓		
Galvanized Iron SL and Plumbing	✓		✓	✓
Non-metal SL and Plumbing	✓			
Unknown or Mixed SL or Plumbing	✓	✓	✓	✓

5. Initial monitoring will be conducted at all participating homes on a monthly basis for three consecutive months, and each resident will be provided with his/her results within 30 days from receipt of the result from the laboratory.

6. A residence with any monthly sample containing greater than 0.015 mg/L lead, 1.3 mg/L copper, or 0.010 mg/L arsenic will be notified as soon as possible and will be resampled within 15 days of the City receiving the laboratory results. If the follow-up confirmation sample also exceeds the regulatory limit for the same constituent exceeded in the initial sample, then it will be classified as Priority 1 residence.

7. After three months of monitoring, residences with no follow-up confirmation sample containing greater than 0.015 mg/L lead, 1.3 mg/L copper, or 0.010 mg/L arsenic will be classified as Priority 2 and will continue on quarterly monitoring for the next three

quarters. If any quarterly sample exceeds 0.015 mg/L lead, 1.3 mg/L copper, or 0.010 mg/L arsenic, the residents will be notified as soon as possible, and a follow-up confirmation sample will be scheduled and collected within 15 days of the City receiving the initial sample results from the laboratory. If the confirmation sample also exceeds the regulatory limit of the same constituent exceeded in the first sample, that residence will be reclassified as Priority 1 and will be put back on monthly sampling frequency.

8. A Priority 1 residence will be offered a bottled water delivery option for drinking and cooking, while it continues to be monitored monthly for the applicable constituents (Table 3) for the remainder of the annual monitoring program. A Priority 1 residence will continue to be classified as such until the results of three consecutive monthly monitoring changes its classification to Priority 2 per the criteria in step 7 above. While a residence is classified as Priority 1, City staff will work with the resident to identify and implement measures to lower the level of the offending constituent. Depending on the constituent of concern and its level, these measures may include frequent flushing, fixture replacement, or others.

9. At the end of each monitoring month, the results of the above monitoring program will be consolidated and summarized in a brief Report and submitted to DDW within 30 days of receiving the last laboratory result for that month.

At the end of the one (1) year period from the start of the monitoring program, the City will prepare a report that presents the full results of the study, and proposes specific mitigation measures, if any, to be implemented at individual residences that continued to be classified as Priority 1 residences by the end of the one-year study. Any such measure will need to be approved by the resident and DDW before it is implemented. The report will be submitted to DDW within 60 days from the conclusion of the one-year monitoring program. After a 30-day review period by DDW, the City and DDW will meet to discuss and define the path forward. During the 90-day period from the end of the one-year monitoring study, any Priority 1 residence will continue to be monitored monthly and continue to receive bottled water service.

Submittals to DDW

The following items will be submitted to DDW's LCR manager:

1. Copies of all letters sent to residents soliciting their participation in the monitoring program.
2. An initial list identifying which contacted residents agreed to participate, which declined to participate, and which did not reply.
3. Monthly updates on the participation status report identified under item 2 above.

In addition, copies of all Consumer Notification forms and Certification of Notice forms will be sent to ddwreports@utah.gov and to DDW's LCR manager within 30 days of receiving the results from the laboratory. However, in the interest of maintaining the confidentiality of individual residents and their results, all communications and reports to DDW and the public will not include the addresses or contact information for a residence. Instead, a unique number between 001 and 270 has been

assigned to each residential address in the monitoring zone. Each number will be tied to that address and will not be reused regardless of whether or not a resident participates in the program, and regardless of whether or not a resident drops out of the program before the completion of the study.

Source Water Assessment

One of the issues raised by DDW is the fact that all the monitoring results will reflect the corrosivity of the specific water entering the system at the time, and that there is no information on whether the outcome would be different if the zone of influence received the City's groundwater instead of surface water. The technical team recognizes that differences in the chemical makeup of the water entering the system can have an effect on the release of metals from pipes and fixtures. The technical team proposes that this matter be addressed by collecting and analyzing the proper water quality parameters from the wells in the vicinity of the zone of influence. These wells, which are shown in Figure 18, are Wells S-8, S-28, S-32, S-34, and S-35. The technical team proposes to focus its source water assessment on these five wells and the surface water entering the system. Therefore, during the course of the 1-year monitoring program, the quality of the City's water supplies will be monitored as follows:

1. Since the five wells in the vicinity of the zone of influence (i.e., Wells S-8, S-28, S-32, S-34, and S-35) are idle, they will be sampled once during this study. When an idle well is to be sampled, it will be pumped to waste for two (2) hours or until the water is clear, whichever occurs later, before samples are collected, after which the well will be shut down. This is in line with the procedure typically used by the operators, although the operators typically terminate the pump-to-waste period in less than two hours if the well water becomes clear in a shorter time.
2. The three surface water entry points (MWDSLS & POMA) shown in Figure 18 will be monitored monthly, which should fully capture the seasonal variability of the source water.
3. One distribution system location inside the zone of influence will be monitored monthly.
4. Any well that is brought online during the 1-year study will be monitored quarterly while it is in service.

Each of the source water quality sample collected will be analyzed for the following water quality parameters (arsenic will be conducted only on groundwater samples):

- pH
- Alkalinity
- Calcium
- Conductivity
- Temperature
- Arsenic (GW only)
- Phosphate
- Chloride
- Sulfate
- Silica
- Lead

The interest in the lead level is not related to the corrosivity of the water, but to quantify any possible contribution of the source water to the lead levels measured at customers' taps.

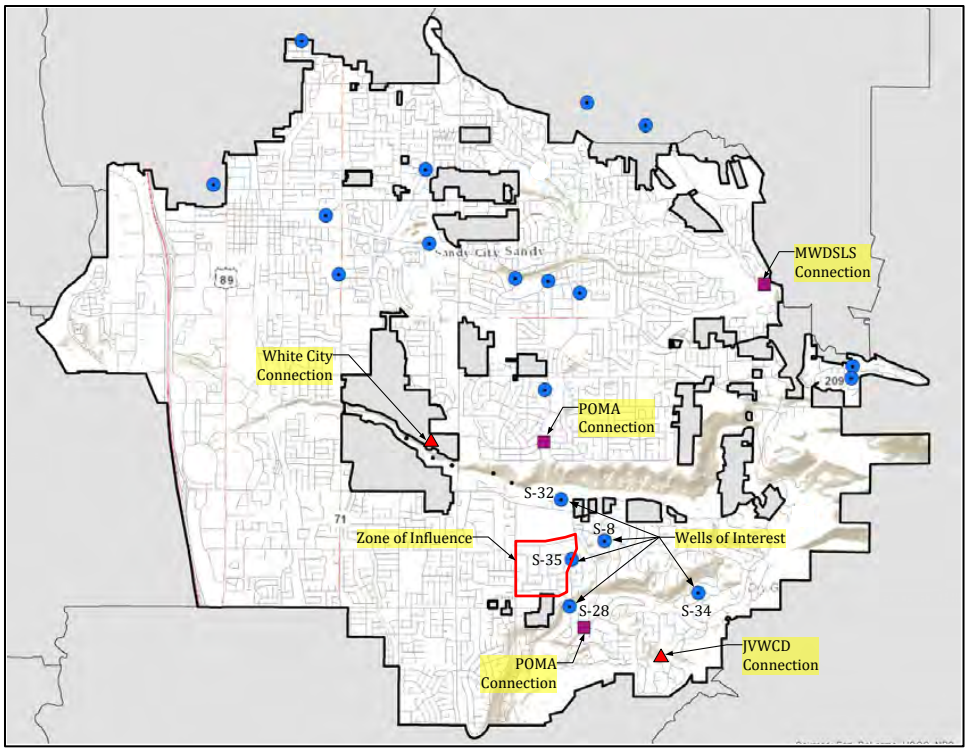


Figure 18 – Water Sources that can Serve the Zone of Influence

The values of the water quality parameters analyzed will be analyzed in two specific areas:

- the first is lead-and-copper solubility
- the second is its ability to precipitate calcium carbonate, $CaCO_3$, which helps minimize metals release.

The metals solubility analysis will utilize the water pH, alkalinity, calcium, conductivity, and phosphate to determine the theoretical solubility of lead and copper into the water. The goal is to determine the chemical state of each metal in contact with the water to determine if it is more likely to be in a soluble or in an insoluble state. This analysis will also use the values of water pH, alkalinity, calcium hardness, conductivity, and temperature to calculate the $CaCO_3$ precipitation indices of interest; primarily the Langelier Saturation Index (LSI) and the Calcium Carbonate Precipitation Potential (CCPP), as well as the Dissolved Inorganic Carbon (DIC) concentration in the water. If the LSI and CCPP values are positive, then the water has the tendency to precipitate $CaCO_3$. If their values are negative, then the water does not precipitate $CaCO_3$, and therefore, does not necessarily help minimize the release of metals into the water.

It is noted that the above analysis of metals solubility and $CaCO_3$ precipitation will be conducted for the quality of each water entering the City's distribution system, as well as a blend of two main sources (i.e., MWDSLS treated water and local groundwater). The Study report will include a complete interpretation of the source water quality data collected, as well as the calculated

precipitation indices, DIC, and metals solubilities, within the context of the anticipated effect of different water sources and blends on the potential for metals release from in-home plumbing.

Anticipated Timeline

There are many steps that need to be completed before monitoring begins. The following activities are on the critical path:

1. Complete the Corrosion Study Plan
2. Obtain approval of the Plan by DDW
3. Prepare the outreach material
4. Submit the Outreach Material to DDW for review and comments
5. Finalize outreach material
6. Send outreach material to 270 residences
7. Send a follow-up set of outreach material to increase participation rate
8. Receive participation responses from residents
9. Coordinate sampling activities with participating residents
10. Obtain and distribute sampling bottles to all participating residents

Other activities that are not on the critical path but need to be conducted in parallel include:

1. Inform Sandy City Council members of the plan details and obtain their support
2. Provide an initial participation report to DDW identifying the number of residents participating in the program, the number of those who declined to participate, and the number of those who did not respond to the solicitation.

In order to complete the above activities, especially those on the critical path, the City anticipates conducting the first monthly monitoring in April 2020. This schedule will also result in the overlap of the first three (3) months of monitoring, which will be conducted on all participating homes, with the spring runoff period when LC water treated by MWDSLS will have the lowest alkalinity.

Summary

This document represents a proposed Plan for a corrosion control study to be completed by the City of Sandy in response to item 8 of the *Issuance of Violations and Administrative Order, Sandy City Drinking Water System (#UTAH18028)* dated March 4, 2019. On February 7, 2019, in response to customer reports of objectionable taste in the City's drinking water, City staff discovered that the hydrofluorosilicic acid feed system at the Paradise Valley Well turned on without flowing water from the well and the acid had been entering the distribution system for the previous 43 hours. City staff immediately shut down the chemical feed system and began an intensive flushing and monitoring effort over the next three weeks.

However, monitoring results collected on February 7 showed that the tap water at many residences in the vicinity of the well contained elevated levels of fluoride (highest measured value was 152 mg/L), as well as high levels of various metals including lead, copper, arsenic, and others, many of which were above their respective drinking water limits. After the offending water was flushed out of the system, the level of metals decreased dramatically. However, the short-term exposure to low-pH water may have dissolved protective scales on the surface of metal pipes and fixtures, and thus made them more susceptible to releasing higher level of metals into the tap water until the protective scales are re-established over time. Therefore, the objective of this study are as follows:

1. Identify, quantify, and track any lingering effects of the event on the quality of the drinking water at the tap in the impacted area.
2. Ensure that the impacted residents are receiving safe drinking water at all times.
3. Identify any long-term mitigation measures that may be required to ensure the safety of the drinking water in the impacted area.

The study Plan includes two types of actions: The first is a one-year monitoring program focused on quantifying the levels of four metals in tap water at the homes impacted by the fluoride over-feed incident, which includes a total of 270 residences. The City will solicit participation in the program from all 270 residences. For those residents participating in the program, the City will work with the residents to monitor their tap water for a full year with a focus on four key metals: lead, copper, arsenic, and iron. The specifics of the monitoring program, monitoring frequency, and resulting actions are detailed in this Plan.

The second part of this Plan is a source water quality monitoring program aimed at quantifying the metal-solubility potential and precipitation potential of the water served to the City's customers. This includes water received from MWDSLS, five City wells in the vicinity of the area impacted by the fluoride over-feed incident, and the water in the distribution system.

Monthly monitoring results will be reported to DDW. In addition, at the end of the one-year monitoring program, the City will prepare and submit a technical report to DDW detailing the results of the overall program and proposing any mitigation measures that may be implemented to address any lingering effects of the incident at specific residences.

In consideration of the activities that need to be completed before monitoring can begin, the City is planning on conducting the first monthly monitoring in April 2020.

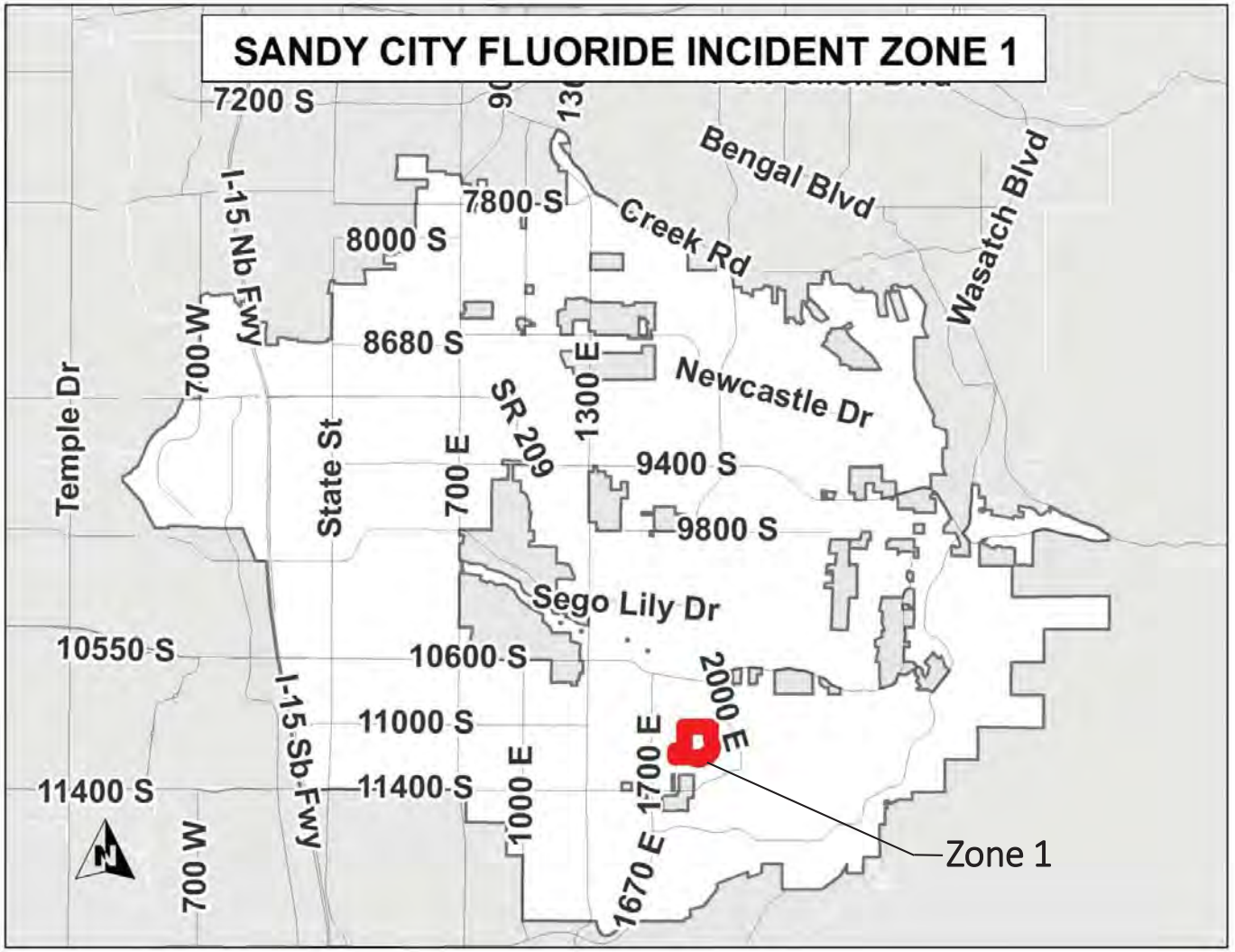
APPENDIX G

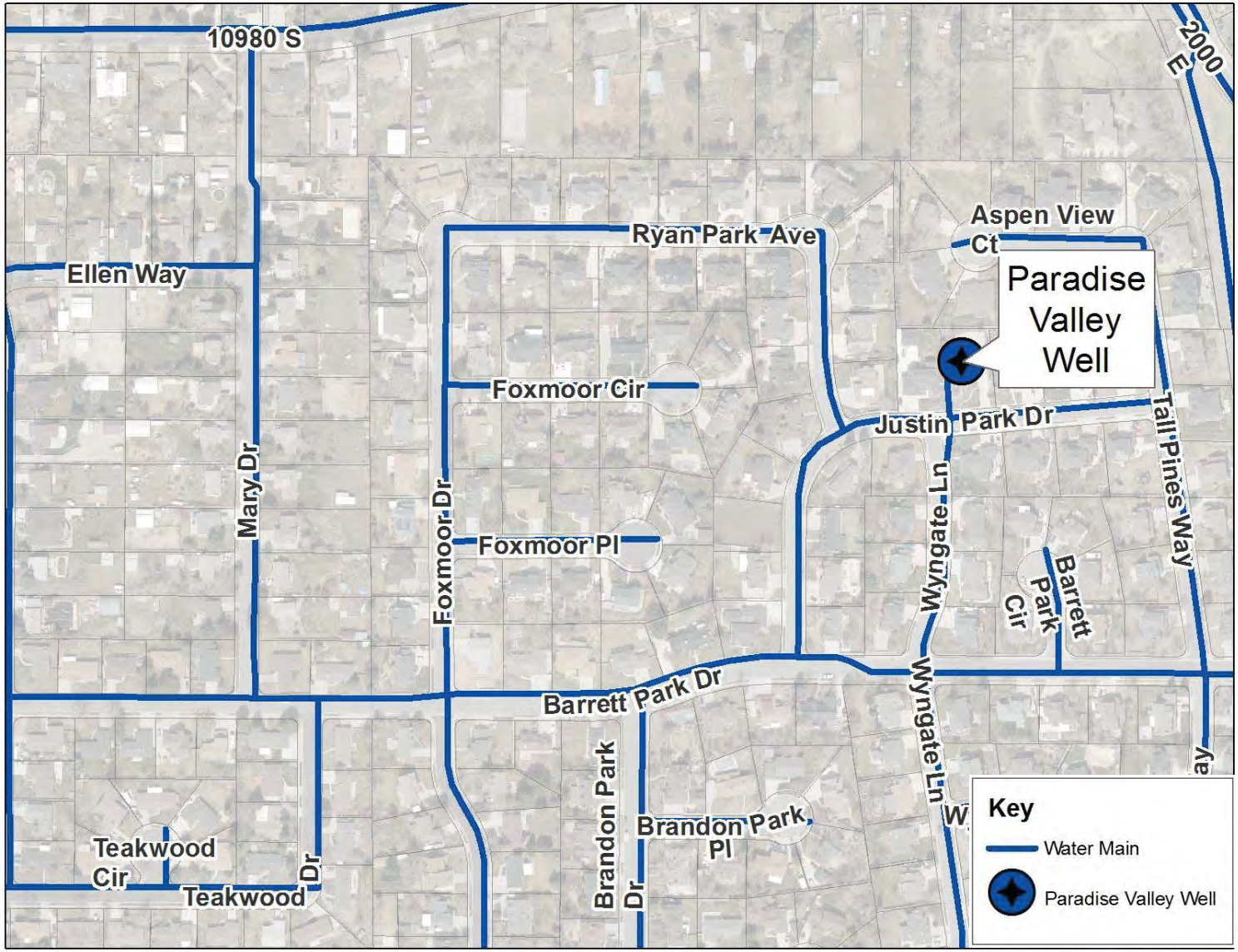
Sandy City Timeline Presentation

FLUORIDE EVENT TIMELINE
February 6-8, 2019

Rev. 4/2/19

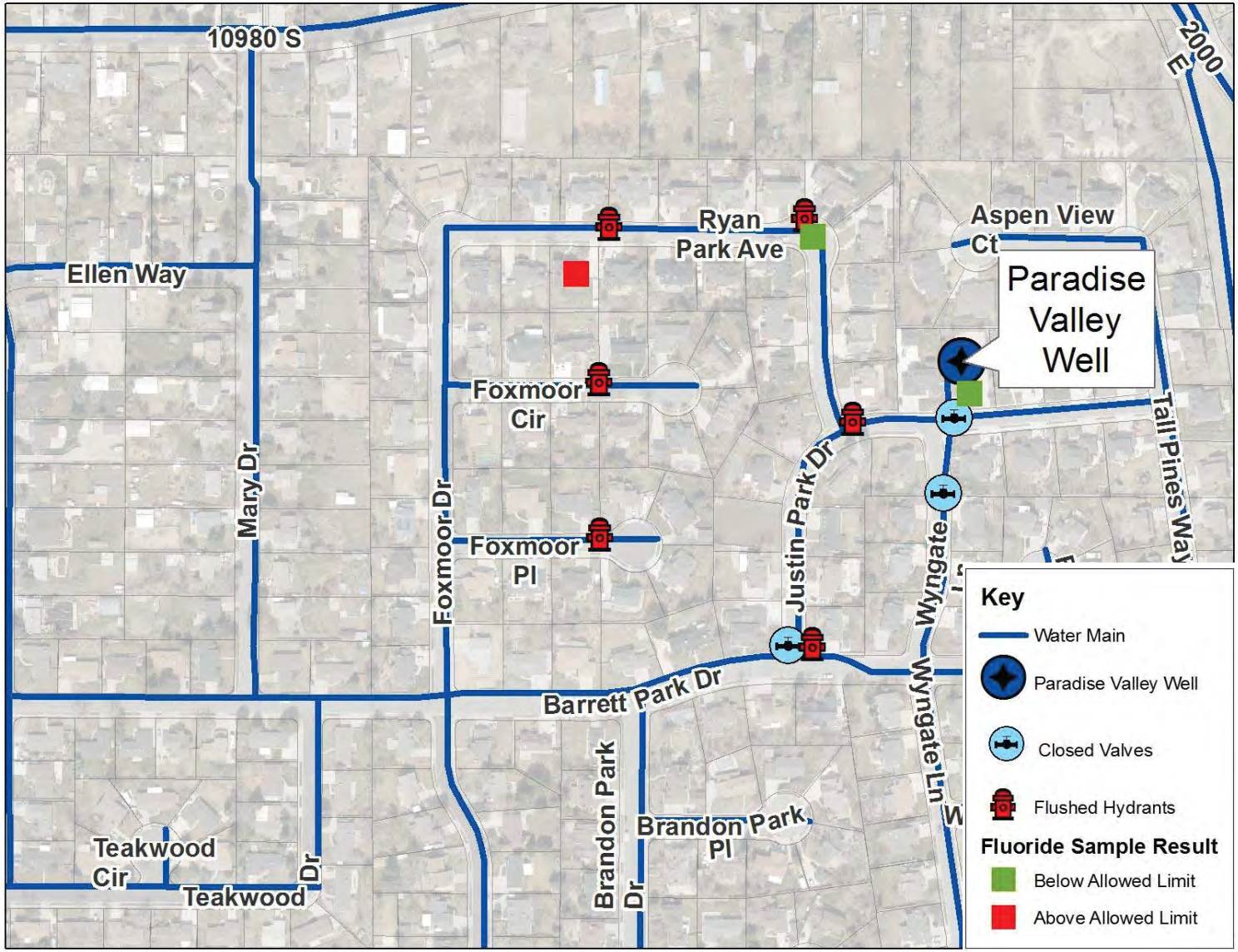
Vicinity Map





Wednesday, Feb. 6

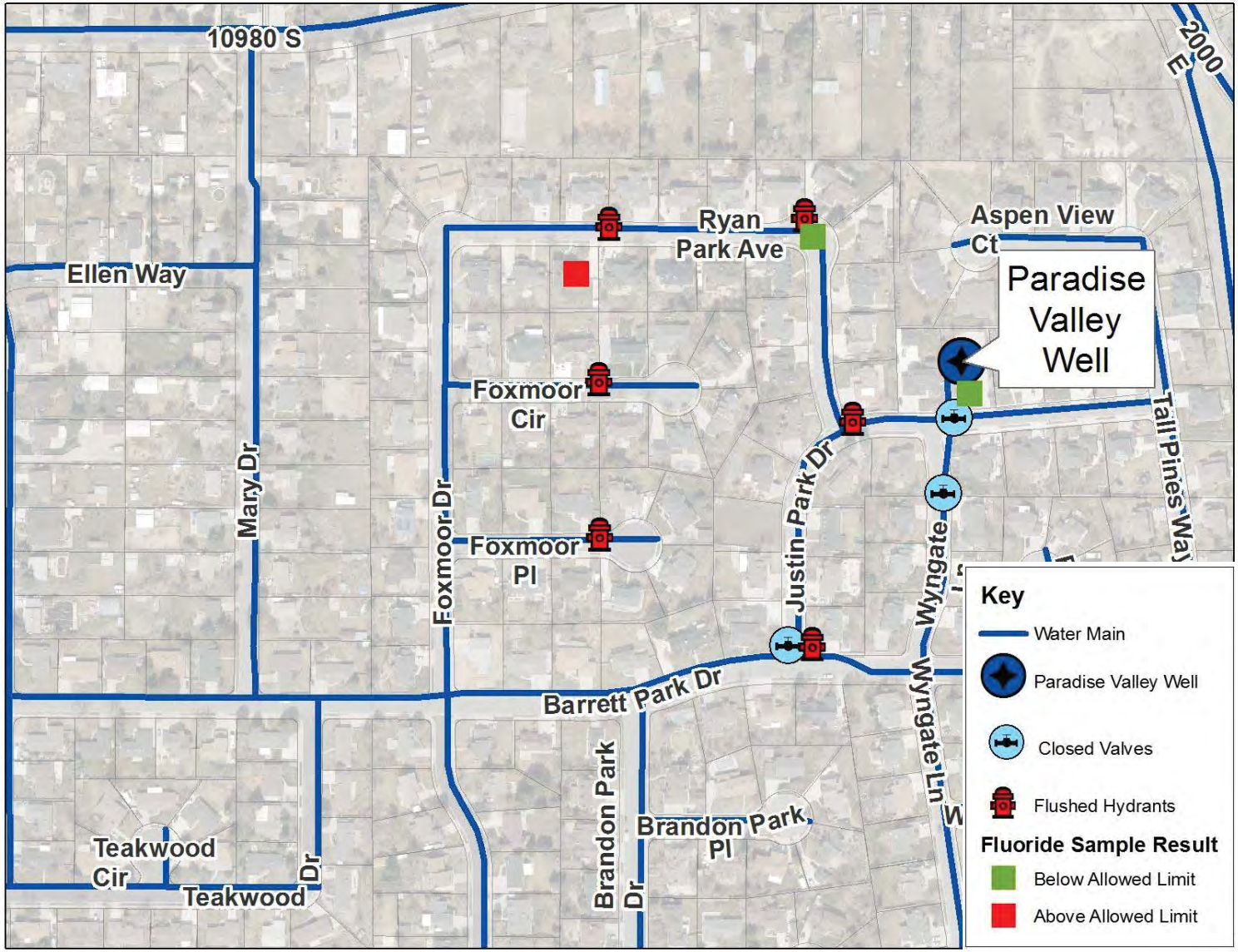
- 4:52 PM – Sandy City personnel received message from Salt Lake City Police Dispatch regarding a call received from resident (on Ryan Park Ave) regarding bad tasting water
- Sandy City personnel promptly made phone contact with resident on Ryan Park Ave (after a brief discussion, the resident hung-up)
- After business hours, Sandy City Fire Department received a 911 call about bad tasting water from resident (on Foxmoor Circle)
- Sandy City did not receive any reports of illness this day



Thursday, Feb. 7

- Morning – Received multiple calls regarding bad tasting water and illness
- 9:30 AM to 11:30 AM
  - Sandy City personnel met with residents in the area by going door-to-door
  - Collected a field sample (1898 Ryan Park Ave) for water quality testing
  - Sandy City sampler tasted water and recognized a potential water quality problem
  - Flushed four fire hydrants (Ryan Park Ave and Justin Park Dr)
  - Dropped off sample to the Metro lab
- Received 9 calls of customer complaints (see attached logs of complaints)

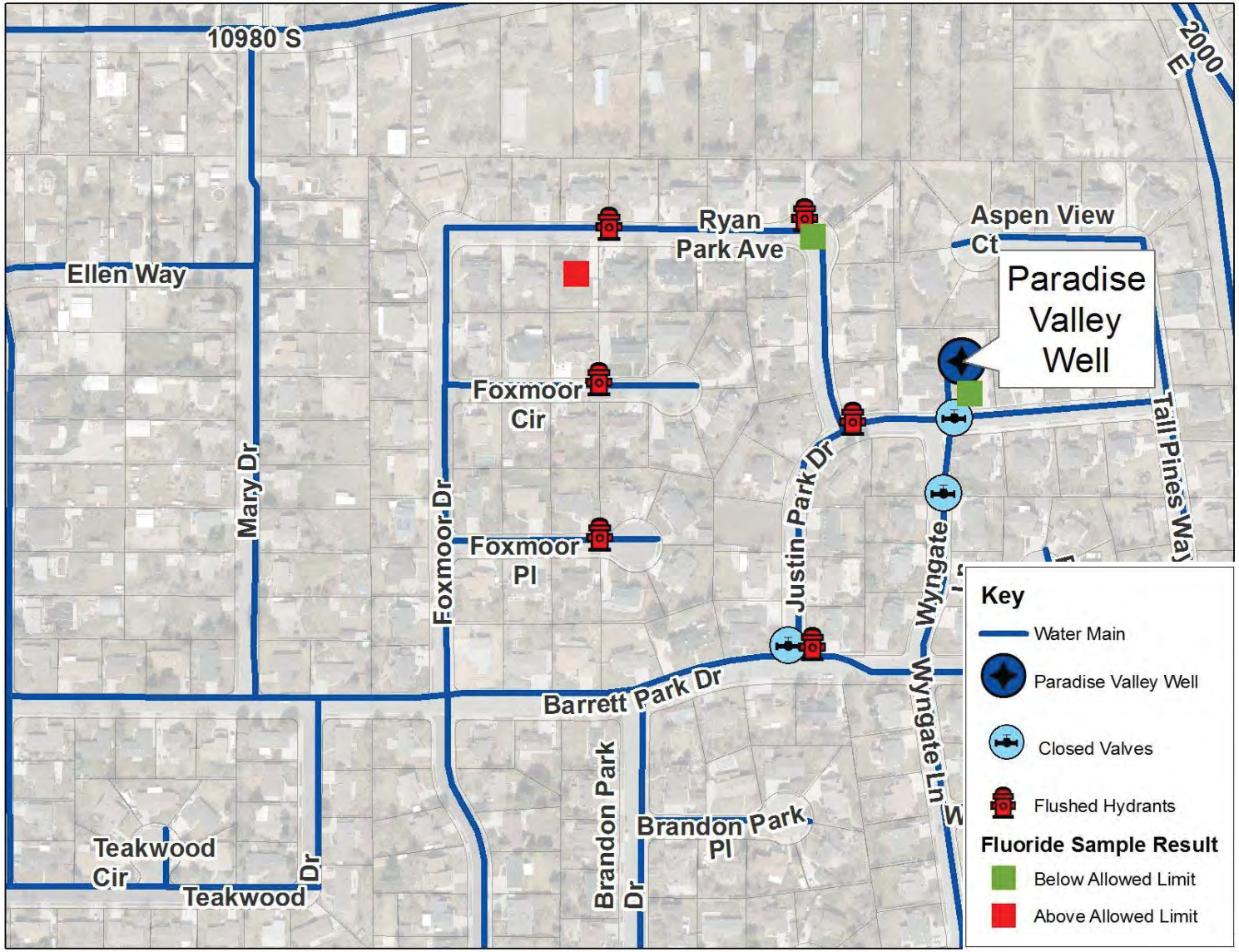
* Times are approximate



Thursday, Feb. 7 (continued)

- 2:00 PM – 4:00 PM
  - Based on earlier metallic taste, Sandy City personnel inspected nearby Paradise Valley Well facility, and identified source of problem (fluoride pump)
  - After identifying the source of the problem, closed valves and flushed all shown hydrants
  - Also flushed at Paradise Valley Well outlet
  - Alerted Salt Lake County Health Dept.
  - Door to door verbal notifications to the residents in immediate area to flush their house plumbing
- Flushed approximately 180,000 gallons from the system

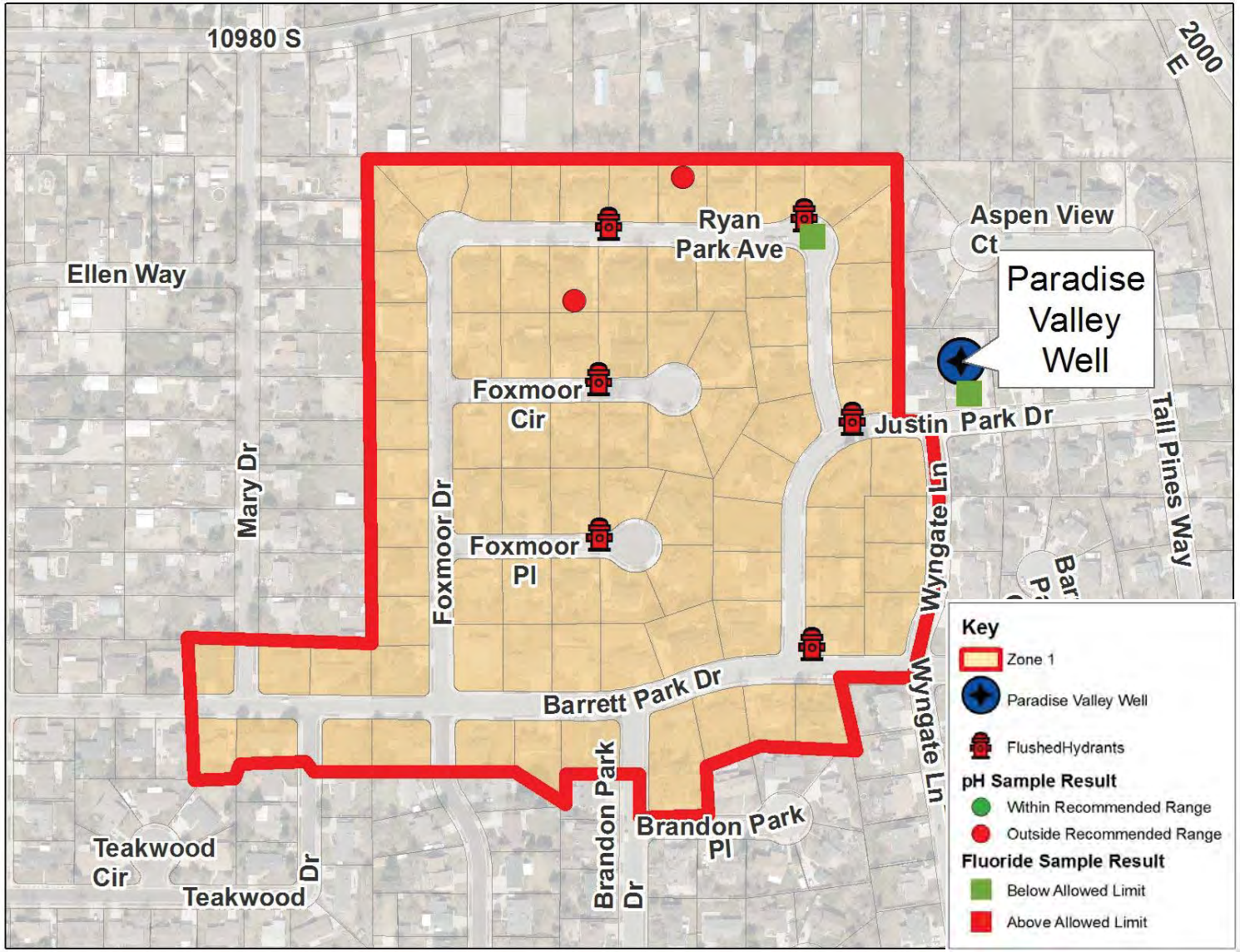
* Times are approximate



Thursday, Feb. 7 (continued)

- 4:30 PM – Received field test lab results from the morning
  - Indicated high fluoride levels (104 mg/L)
- 5:00 PM – Field tests showed fluoride levels back to allowable limits (0.78 mg/L & 1.1 mg/L)

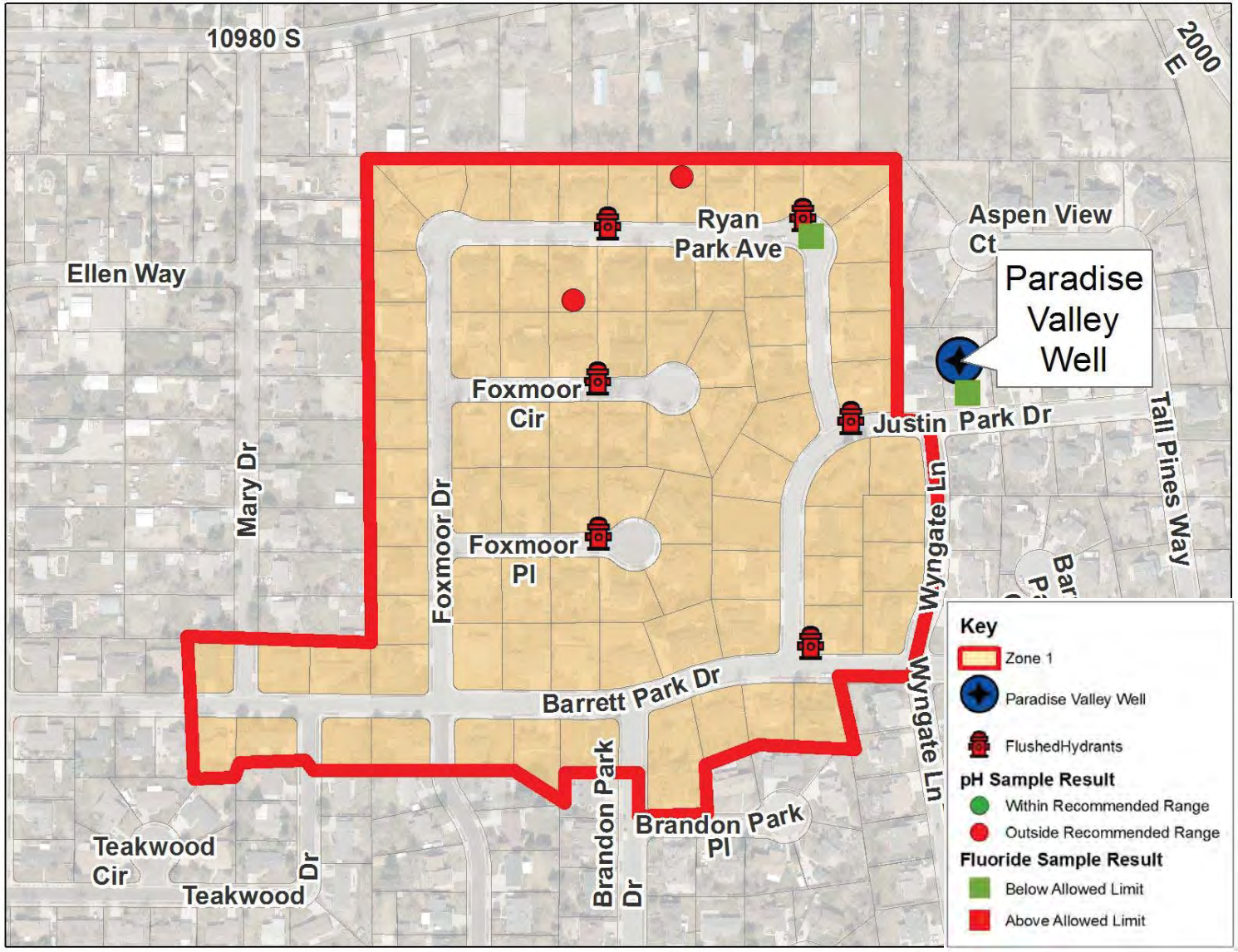
* Times are approximate



Friday, Feb. 8

- 11:00 AM – Conference call with County and State agencies
- Received pH results from Metro for samples collected on Feb 7 (3.9 and 3.8)
- 5:30 PM to 8:00 PM – Distributed public notices to Zone 1 (shown in red outline)

* Times are approximate



Friday, Feb. 8

- Continued flushing at hydrants and the well
- Still waiting on certified full lab results
- No customer water quality complaints received this day

* Times are approximate

** Areas shown on map are all within Pressure Zone 3A

*** Generally water flows from east to west in this area

**** All references in this document are subject to modification based on additional information obtained

APPENDIX H

Chain of Custody (February 7, 2019)

APPENDIX I

Sandy City Town Hall PowerPoint Presentation

While you wait, please register your phone for Reverse 911 - http://www.vecc9-1-1.com/voip-registration/

1

Water Quality Town Hall

February 18, 2019

2

Tonight's Overview

1. Welcome and Introductions – Mayor Bradburn
2. Overview – Mayor Bradburn
3. Event Timeline – Tom Ward
4. Event Summary – Mayor Bradburn
5. Next Steps – Mayor Bradburn
6. Common Questions and Answers – Mayor & Expert Panel

3

General Information

- sandy.utah.gov
- Water testing - sandy.utah.gov/water-testing
- Reverse 911 sign up

4

Tuesday 2/5

- Large storm resulting in power outage
- Fluoride pump malfunction in city well

5

Wednesday 2/6

- 4:50 PM – Dispatch call regarding bad tasting water
- Public Utilities made contact that night

6

Thursday 2/7

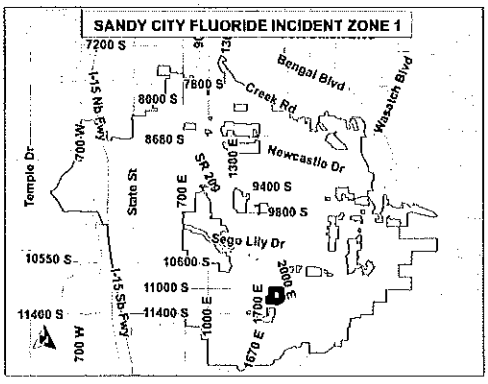
- 8:30 AM – Multiple calls regarding bad tasting water and illness
- 9:30 AM – Met with residents, started field sampling and flushing system
- 10:00 AM – Dropped off samples to primary lab
- 2:00 PM – Identified source of problem (fluoride pump)
- Alerted SLCo Health Department
- Door to door notifications to residents
- 4:30 PM – Lab tests from AM samples confirmed high fluoride levels
- 5:00 PM – Field tests showed fluoride levels back to safe limits

7

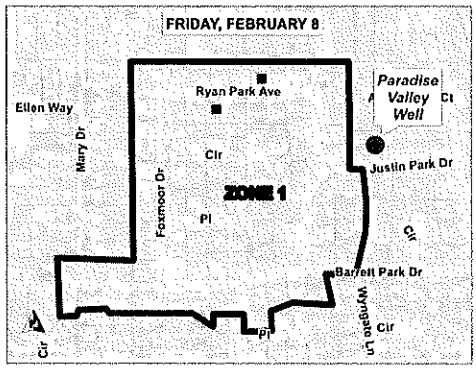
Friday 2/8

- No new water or illness calls
- 8:30 - Contacted State Division of Drinking Water
- 11:00 AM – Conference call with county and state agencies
- 4:30 PM – Coordinated public notice with agencies
- 5:30 PM – Distributed public notices to Zone 1

8



9



10

Saturday 2/9

- No new water or illness calls
- Flushed the well
- System levels completely normalized

11

Sunday 2/10

- No new water or illness calls
- Lab report = still waiting

12

Monday 2/11

- No new water or illness calls
- Original two samples received by backup lab
- Flushing and sampling continues
- Lab report = still waiting
- Field sample results all positive
- 1:00 PM Conference call with state and county agencies – fluoride update

13

Tuesday 2/12

- No new water or illness calls
- Flushing and sampling continues
- Evening: New report of previous illness outside of Zone 1

14

Wednesday 2/13

- No new water or illness calls
- Lab report = still waiting
- Flushing and sampling continues
- Created Zone 2
- Door to door notices distributed to Zone 2
- Follow up conference call with state and county agencies – instructed city to continue flushing and sampling

15

Thursday 2/14

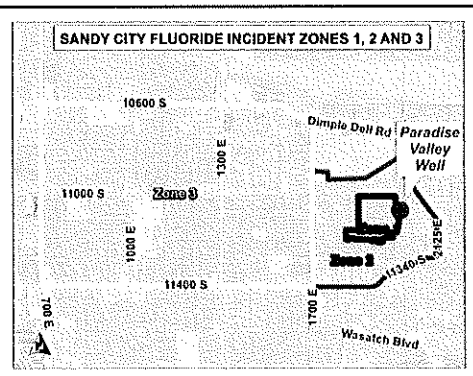
- No new water or illness calls
- Mid-afternoon: Certified lab results received - Data and color discrepancies
- Initiated sample chain of command to correct

16

Friday 2/15

- 10:00 AM – Forwarded lab report to state and county agencies
- 1:00 PM – Meeting with state agency
- Discovered fluoride event caused secondary lead and copper event
- 6:00 PM – Press Release and Media Conference
- Created Zone 3
- Reverse 911 – instructed Zones 1-3 to flush

17



18

Saturday 2/16

- Inadequate flushing notification - initiated No Drink Order
- Initiated Emergency Operation Center
- Began AM lead and copper sampling (28 across all 3 Zones)
- Afternoon sampling continued (160+, Zones 1 & 2)
- Water Distribution Stations
- Door to door outreach notice (1st responders)
- Established emergency call center
- All 28 lab results received within safe drinking water limits
- Received expanded metal panel results (on samples taken 2/7)

19

Sunday 2/17

- 9:00 AM - Zone 3 No Drink Order Lifted due to positive lab results
- EOC continued
- Continued heavy sampling Zone 1 & 2... & 3
- Continued sampling
- Saturday samples received – 192 positive results, one elevated lead result
- 7:00 PM - Joint agencies lifted No Drink Order (Zone 1 & 2)

20

Monday 2/18

- Expanded volunteer sampling (Zone 3)
- Continued communications outreach
- Continued joint agency coordination
- Continued receiving positive lab results
- Town Hall Meeting

21

Summary

- Primary Event: Elevated Fluoride Event (2/5 - 2/7)
- Secondary Event: Lead and copper (2/15 - 2/17)
- Reversed No Drinking Order within 48 hours

22

Common Questions

1. Will I be contacted with my sample/lab results?
2. Is my drinking water truly safe?
3. Can we eliminate fluoride from our water?
4. Are there personal health effects?
5. Will there be a credit for flushing?
6. What will be the reimbursement process?
7. What happens if I have sediment, murky or colored water in my home?

23

Common Questions Continued

1. Why didn't I hear about this sooner?
2. What are we doing to improve our communication with the community in case of future emergencies?
3. Claim of damage requests - https://sandy.utah.gov/departments/city-recorder/claim-of-damages-request

24

Lessons Learned

- How the city is preventing this from happening in the future?
- Next Steps
  - Continuing investigation to prevent this
  - Working with City Administration to improve communication
  - Hire independent outside expert for full report and recommendations
  - Ongoing sampling

25

Questions and Answers

26

APPENDIX J

Pipe and Faucet Replacement Invoices

TERRY'S PLUMBING, INC.

REPAIR & REMODEL

3338

4205 S. 900 E., Salt Lake City, UT 84124

Phone: 801-856-9875
801-262-7151
Fax: 801-269-9986
Email: tplmbinc@earthlink.net.

Work	Home	Work	Home
Billing Address		Work Address [redacted]	
City		[redacted]	
		SANDY, UT 84094	

Quan.	Unit Price	Description of Parts or Material	Amount
1	135	BATHROOM TAP	135 00
1	155	KITCHEN TAP	155 00
1		PTRAP	4. 00
1		BASIN SUPPLYS + NUT + FERREL	8. 00

Labor Performed	Time In: 10:00 Time out: 12:30 Men: 2	Total Material	302 00
REPLACED KITCHEN SINK TAP + BATHROOM SINK + AP. WITH MOEN LEAD FREE VALVES. PAID CHECK # 4942		Total Labor	412.50
		Truck Chg.	50 00
		Total Amount	764. 50

Date Compl. 3-7-19	Deposit PAID CHECK	Empl. SHANNON + TOSH

Holder agrees to pay costs and attorney's fees if any delinquent balance over 30 days is due or is placed with collection agency. This job has been completed to my satisfaction and I understand the statment above: X [signature]

Check request
40094

Service Matters

1450 South 1000 West
Salt Lake City, UT 84104
Ph: 801-381-3583
Fax: 801-972-1372
goodhealthanswers@msn.com

July 18, 2019

Invoice

Customer: [redacted]ast Susan Dr.
Sandy, UT

Provide materials and labor to replace water piping serving basement bathroom and laundry in order to mitigate lead contamination and to enable access to water lines.

Includes:

- Removal of refrigerant
- Temporary removal of furnace and AC coil
- Replacement of water lines
- Reinstallation of furnace and ac coil
- Pressure testing, evacuation and recharging
- New two-handle tub and shower valve
- New shut off valve for water closet and laundry

Excludes:

- Any upgrades to current codes of HVAC or water supply system
- Wall patch/painting repairs
- Repairs to HVAC system not related to this project

Price reflects using PEX tubing with brass or plastic crimp-style fittings.

$4,886.00

Upgrade to use type m standard thickness copper tubing $500.00

Total: $5,386.00

EXPERT
PLUMBING, HEATING, AIR & ELECTRICAL
It doesn't hurt to call an expert!

Expert Home Services
Expert Plumbing Services
1190 North 1200 West
Orem, UT 84057
801-224-8118

Invoice 27872756
Invoice Date 3/26/2019
Completed Date 3/26/2019
Customer PO

Billing Address
Sandy City Public Utilities
10000 Centennial Parkway
Sandy, UT 84070 USA

Job Address
[redacted]Susan Drive
Sandy, UT 84092 USA

Description of Work

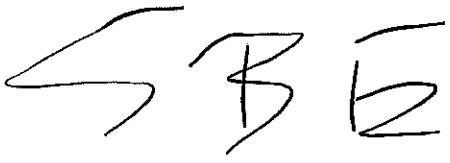
Removed old cobtaminated faucet, supplies, and stop. Replaced with new city supplied materials. No parts warranty.

Task #	Description	Quantity	Your Price	Your Total
Owner Supplied Faucet	Install owner supplied faucet 1 year labor only warranty	1.00	$175.40	$175.40
Angle Stop	Angle Stop 2 year parts and labor warranty unless damage is due to high water pressure.	2.00	$43.70	$87.40
Lavatory Supply Line	Lavatory Supply Line 2 year parts and labor warranty unless damage is due to high water pressure.	2.00	$20.00	$40.00

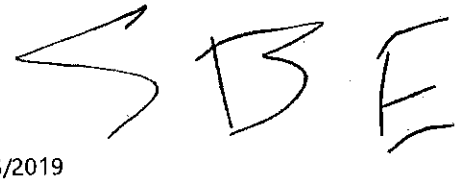
Sub-Total	$302.80
Tax	$0.00
Total Due	$302.80
Balance Due	$302.80

Thank you for your business!

Authorization to perform work listed above for the the amount of $302.80
I have the authority to order the above work to be performed at [redacted] Susan Drive, Sandy, UT 84092 USA and so order Expert Plumbing, Heating, Air and Electrical will retain title to any equipment or material furnished until the final and complete payment is made. I agree to authorize and pay the amount listed above at time of completion of the work performed. I understand that billing is not acceptable unless otherwise stated above and approved by the accounts receivable manager. If settlement is not made as agreed, the seller shall have the right to remove same and the seller will be held harmless for any damages resulting from the removal thereof. I have read and agree to the following Terms and Conditions and will not hold Expert Plumbing, Heating, Air and Electrical liable.
Authorization Signature:



3/26/2019
Acceptance of the Work Performed:
I find the service and materials rendered and installed in connection with the above work mentioned, to have been completed in a satisfactory manner. I agree that the amount of $302.80 to be the total complete charge. I understand that I will be charged a $35 fee for "Non-Sufficient Funds" for checks. I understand that I will be charged interest of 18% monthly for approved billing or non-sufficient funds checks if not paid within 30 days of completed work. I agree to pay reasonable attorney's fees and court costs in the event of legal action. I acknowledge that I have read and received a legible copy of this contract and have read the Terms and Conditions during Authorization and will not hold Expert Plumbing, Heating, Air and Electrical liable.
Acceptance of Work Performed Signature:



3/26/2019

We Specialize In Service
NEERINGS
Plumbing & Heating, Inc.
Air Conditioning • Electric • Drain Cleaning

Neerings Plumbing & Heating Inc.
3495 S 300 W
Salt Lake City, UT 84115
801-467-3951

Invoice 10517316
Invoice Date 3/16/2019
Completed Date
Customer PO

Billing Address
[redacted]
1000 Centennial Parkway
Sandy, UT 84092 USA

Job Address
[redacted] East Ryan Park Avenue
Sandy, UT 84092 USA

Description of Work

Replaced faucets and hose bibs

Task #	Description	Quantity	Your Price	Your Total
133.012	Install Customer Supplied Lavatory Faucet & Pop-Up Assembly (Does Not Include Faucet Removal, Stops or Trap)	3.00	$350.00	$1,050.00
048.002	fhb Freezeless Hose Bibb, Open Access	1.00	$803.00	$803.00

Paid On	Type	Memo	Amount
3/16/2019	Visa		$1,853.00

Potential Savings	$185.14-$185.30
Sub-Total	$1,853.00
Tax	$0.00
Total Due	$1,853.00
Payment	$1,853.00
Balance Due	$0.00

I hereby authorize the work described and agree to the terms and conditions as stated as part of this digital form. I recognize that aged and deteriorated plumbing or mechanical fixtures, piping, and appurtenances may no longer be serviceable, and agree to hold Neerings Plumbing & Heating Inc. blameless for any damage or distraction to those conventional repair efforts. I agreed to pay for all work, goods, and services received, and hereby further authorize Neerings Plumbing & Heating Inc. to investigate my credit record and bill any of my credit cards for the goods and or services being provided, and I agreed to perform the obligations set forth in the applicable cardholder agreement with the credit card issuer. I represent that I am either the owner of the property or the owner's agent, and have authority to order said work. A service charge of 1-½% per month (18% per annum) will be charged on all balances 30 days or more past due. All makers, endorsers, sureties, and guarantors agreed to pay all costs of collection, including reasonable attorneys fees. All sales are final.

3/16/2019
I hereby acknowledge the satisfactory completion of the above described work.

3/16/2019
I authorize Neerings Plumbing & Heating Inc. to charge the agreed amount to my credit card provided herein. I agree that I will pay for this purchase in accordance with the issuing bank cardholder agreement.

3/16/2019

EXPERT
PLUMBING, HEATING, AIR & ELECTRICAL
It doesn't hurt to call an expert!

Expert Home Services
Expert Plumbing Services
1190 North 1200 West
Orem, UT 84057
801-224-8118

Invoice 27879935
Invoice Date 3/29/2019
Completed Date 3/29/2019
Customer PO

Billing Address
Sandy City Public Utilities
10000 Centennial Parkway
Sandy, UT 84070 USA

Job Address
[redacted] East Ryan Park Avenue
Sandy, UT 84092 USA

Description of Work

Remove old copper run for garage sink. Replace with new pex lines

Task #	Description	Quantity	Your Price	Your Total
Repipe House	Repipe House 2 year parts and labor warranty.	1.00	$800.00	$800.00
Main Shut off Valve	Emergency shut off valve up to 1" gate or ball valve. 2 year parts and labor warranty unless damage is due to high water pressure.	1.00	$408.10	$408.10

Sub-Total	$1,208.10
Tax	$0.00
Total Due	$1,208.10

Balance Due $1,208.10

Thank you for your business!

Authorization to perform work listed above for the the amount of $1,208.10
I have the authority to order the above work to be performed at [redacted] East Ryan Park Avenue, Sandy, UT 84092 USA and so order Expert Plumbing, Heating, Air and Electrical to do so as outlined above. It is agreed that Expert Plumbing, Heating, Air and Electrical will retain title to any equipment or material furnished until the final and complete payment is made. I agree to authorize and pay the amount listed above at time of completion of the work performed. I understand that billing is not acceptable unless otherwise stated above and approved by the accounts receivable manager. If settlement is not made as agreed, the seller shall have the right to remove same and the seller will be held harmless for any damages resulting from the removal thereof. I have read and agree to the following Terms and Conditions and will not hold Expert Plumbing, Heating, Air and Electrical liable.
Authorization Signature:

3/29/2019
Acceptance of the Work Performed:
I find the service and materials rendered and installed in connection with the above work mentioned, to have been completed in a satisfactory manner. I agree that the amount of $1,208.10 to be the total complete charge. I understand that I will be charged a $35 fee for "Non-Sufficient Funds" for checks. I understand that I will be charged interest of 18% monthly for approved billing or non-sufficient funds checks if not paid within 30 days of completed work. I agree to pay reasonable attorney's fees and court costs in the event of legal action. I acknowledge that I have read and received a legible copy of this contract and have read the Terms and Conditions during Authorization and will not hold Expert Plumbing, Heating, Air and Electrical liable.
Acceptance of Work Performed Signature:

3/29/2019

EXPERT
PLUMBING, HEATING, AIR & ELECTRICAL
It doesn't hurt to call an expert!

Expert Home Services
Expert Plumbing Services
1190 North 1200 West
Orem, UT 84057
801-224-8118

Invoice 28158856
Invoice Date 5/15/2019
Completed Date 5/15/2019
Customer PO

Billing Address
Sandy City Public Utilities
10000 Centennial Parkway
Sandy, UT 84070 USA

Job Address
[redacted]
[redacted] East Ryan Park Avenue
Sandy, UT 84092 USA

Description of Work

Remove old copper lines and replace with pex. Will also install new shut offs under sink

Task #	Description	Quantity	Your Price	Your Total
Hot or Cold Shut-off Assembly	Hot or Cold Shut-off Assembly. 2 year parts and labor warranty unless damage is due to high water pressure.	2.00	$196.90	$393.80
Repipe House	Repipe House 2 year parts and labor warranty.	1.00	$625.00	$625.00

Sub-Total	$1,018.80
Tax	$0.00
Total Due	$1,018.80
Balance Due	$1,018.80

Please note that Expert Plumbing Heating Air & Electrical has a new address

Thank you for your business!

Authorization to perform work listed above for the the amount of $1,018.80
I have the authority to order the above work to be performed at [redacted] East Ryan Park Avenue, Sandy, UT 84092 USA and so order Expert Plumbing, Heating, Air and Electrical to do so as outlined above. It is agreed that Expert Plumbing, Heating, Air and Electrical will retain title to any equipment or material furnished until the final and complete payment is made. I agree to authorize and pay the amount listed above at time of completion of the work performed. I understand that billing is not acceptable unless otherwise stated above and approved by the accounts receivable manager. If settlement is not made as agreed, the seller shall have the right to remove same and the seller will be held harmless for any damages resulting from the removal thereof. I have read and agree to the following Terms and Conditions and will not hold Expert Plumbing, Heating, Air and Electrical liable.
Authorization Signature:

5/15/2019
Acceptance of the Work Performed:
I find the service and materials rendered and installed in connection with the above work mentioned, to have been completed in a satisfactory manner. I agree that the amount of $1,018.80 to be the total complete charge. I understand that I will be charged a $35 fee for "Non-Sufficient Funds" for checks. I understand that I will be charged interest of 18% monthly for approved billing or non-sufficient funds checks if not paid within 30 days of completed work. I agree to pay reasonable attorney's fees and court costs in the event of legal action. I acknowledge that I have read and received a legible copy of this contract and have read the Terms and Conditions during Authorization and will not hold Expert Plumbing, Heating, Air and Electrical liable.
Acceptance of Work Performed Signature:

5/15/2019